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FORAMINIFERA FROM THE DUCK CREEK
FORMATION OF OKLAHOMA AND TEXAS

A DISSERTATION SUBMITTED TO THE FACULTY OF THE
DIVISION OF THE PHYSICAL SCIENCES IN CANDIDACY
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF GEOLOGY AND PALEONTOLOGY

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HELEN TAPPAN

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FORAMINIFERA FROM THE DUCK CREEK FORMATION
OF OKLAHOMA AND TEXASHELEN TAPPAN¹

Tulane University, New Orleans, Louisiana

ABSTRACT—One hundred and twenty species of Foraminifera are described from the Lower Cretaceous Duck Creek formation of southern Oklahoma and northern Texas, of which 37 are new. Twenty-eight of the previously described species are recorded from this formation for the first time. Five generic ranges are extended downward into the Lower Cretaceous. These are *Ammobaculoides* and *Hastigerinella*, which had not previously been recorded below the Upper Cretaceous, and *Siphotextularia*, *Unicosiphonia* and *Stichocibicides*, not previously known below the Tertiary. One new genus, *Washitella*, is described.

INTRODUCTION

THE Duck Creek is the basal formation of the Washita group of the Comanche series. The type locality of the formation is on Duck Creek, at the edge of the Red River Valley, about three miles north of Denison, Texas (locality HTL-34). The Duck Creek overlies the Kiamichi formation of the Fredericksburg group and is overlain by the Fort Worth limestone. The formation is thickest and best exposed in the northern part of the outcrop, the greatest thickness occurring in Love County, southern Oklahoma and Grayson County, northern Texas, where it is about 120 feet in thickness. The formation thins southward, being about 100 feet thick in Cooke and Denton counties and 62 feet in Tarrant County, which is the southernmost county considered in the present paper. The Duck Creek decreases in thickness still more to the south, however, being only 20 to 25 feet thick in the vicinity of Austin, in central Texas.

It is interesting to note that the most abundantly fossiliferous samples were from the north, where the formation is thickest. This is especially true of the locality in Love County, Oklahoma (HTL-13), one of the best sections for the collection of samples from the Duck Creek, although no Foraminifera have been previously recorded from this formation in Oklahoma, to the knowledge of the writer.

As the geologic range in this area is given for the various species, as far as is known, a table is given showing the formations of the

Comanche series which crop out in this region, and their correlation with the European section, as evidenced by the Foraminifera.

DESCRIPTION OF LOCALITIES
AND SAMPLES

Forty-three samples were collected from eight localities, distributed through Love County in southern Oklahoma, and Grayson, Cooke, Denton and Tarrant Counties in northern Texas. These are listed below in the order of the locality numbers, as only the locality and sample numbers are given in the discussion of the various species to avoid repetition of the locality descriptions.

Locality HTL-13.—Collected in August 1939 on the west bank of the Red River, in the SW. $\frac{1}{4}$ sec. 22, T. 8 S., R. 2 E., on the southwest side of Horseshoe Bend, Love County, Oklahoma.

Sample number	Thickness (feet)	Description
122	6.5	Top of section, just beneath the basal fucoid-bearing limestone of the Fort Worth limestone. Alternating gray shales and limestones.
121	5.5	Alternating gray shale and marly limes.
120	5.5	Gray shale.
119	5.5	Gray shale.
118	5.5	Alternating gray shale and marly limestone.
117	6.5	Blue-gray shale.
116	5.5	Blue-gray shale.
115	5.5	Blue-gray shale.
114	5.5	Blue-gray shale.
113	5.5	A 6-inch limestone bed at the top, remainder alternating blue-gray shale and limestone

¹ Mrs. Alfred R. Loeblich, Jr.

SUBDIVISIONS OF THE COMANCHE SERIES

	Southern Oklahoma	Northern Texas	Southern Texas	Europe
Washita group	Grayson marl	Grayson marl	Buda limestone Del Rio clay	Albian
	Bennington ls.	Main Street ls.	Georgetown ls.	
	Bokchito fm.	Paw Paw sand Weno clay Denton clay		
	Caddo fm.	Fort Worth ls. Duck Creek fm.		
Fredericksburg group	Kiamichi clay Goodland ls.	Kiamichi clay Goodland ls. Walnut clay	Edwards ls. Comanche Peak ls. Walnut clay	
Trinity group	Trinity sand	Paluxy sand Antlers sand	Paluxy sand Glen Rose ls. Travis Peak ss.	Aptian

112 6 Upper 3 feet of blue-gray alternating shales and limestones, then a massive 2-foot limestone bed beneath this, with 1 foot of blue-gray shale beneath the limestone. Ammonites.

5 Talus covered, no sample.

1 Limestone ledge, no sample.

110 1 Blue-gray marl, base of section exposed.

Locality HTL-27.—Collected in July 1938 on Duck Creek, in the east bank and in the cut of the Missouri, Kansas and Texas railroad, which is above and to the east of the creek bank, east of Highway 75, 2½ miles north of Denison, in Grayson County, Texas.

Sample number	Thickness (feet)	Description
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165	1	20 feet above the base of the formation, in the cut of the Missouri, Kansas and Texas Railroad.
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169	3	Light-yellow marl, alternating with marly limestone, uppermost part of section exposed in the banks of Duck Creek.
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168	3	Yellow-gray marl, just below sample 169.
-----	---	--

	1.3	Limestone, no sample.
--	-----	-----------------------

167	2.5	Alternating blue limestones and shales.
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	0.8	Marly limestone, no sample.
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	0.7	Blue-gray marl.
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Sample 165 is from the railroad cut, while samples 166 to 169, inclusive, are from the creek bank and stratigraphically lower, although the exact amount below is uncertain.

Locality HTL-34.—Collected in September

1938. The type locality of the Duck Creek formation, in the banks of Duck Creek and in the railroad cut, where the St. Louis and San Francisco Railroad comes close to the creek, 2½ miles north of Denison, on Highway 75 and east of the road, in Grayson County, Texas.

Sample number	Thickness (feet)	Description
---------------	------------------	-------------

218	10	Just below the Fort Worth limestone in the railroad cut. Yellowish-gray shale and marl with some limestones.
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217	5.5	Yellowish gray shale or marl with some limestones. Just below sample 218, in the railroad cut.
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22		Grass-covered, from the base of the railroad cut to the top of the creek bank. No samples.
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216	4	Light grayish-yellow marls alternating with nodular limestones.
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215	5.5	Yellowish marl with a 20-inch limestone bed at the top. Fucoids on its under side.
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214	5.5	Upper part of yellowish marl, becoming bluish toward the base but weathering to yellow.
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213	5.5	Alternating marls and 4- to 6-inch limestones.
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212	5.5	Alternating thin limestones and marls with an 11-inch limestone at the base.
-----	-----	--

211	7.2	Dark-gray shale alternating with 2- to 3-inch limestone beds.
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210	5.5	Marl, with a 17-inch heavy bed of marly limestone at the base. Bottom of section, base of the Duck Creek formation.
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Samples 210 to 216, inclusive, are exposed in the creek bank, samples 217 and 218 are exposed in the railroad cut above.

Locality HTL-35.—Collected in June 1939 in a road cut on the east side of the road, just inside the entrance to Forest Park, 0.4 miles due north of the northeast corner of the campus of Texas Christian University, in Fort Worth, Tarrant County, Texas. The road cut forms a 12-foot bluff.

Sample number	Thickness (feet)	Description
		Heavy limestones at top of exposure, no sample.
278	4	Interbedded nodular limestones and yellow-gray shale, just below the heavy limestones. This zone is more limy than the underlying material.
277	6	Yellow-gray shale interbedded with marly limestone toward the base. Bottom of exposure.

Locality HTL-38.—Collected in September 1938. The upper Duck Creek is exposed in a low north-facing cliff forming the south bank of Hickory Creek 150 feet north of the road, where the road leading northwest from Krum to Trinity Farms crosses the creek, 8 miles northwest of Krum, Denton County, Texas.

Sample number	Thickness (feet)	Description
224	3	Entire section exposed, alternating limestones and shaly marls, just below the stream gravel.

Locality HTL-42.—Collected in September 1938 in a high east-facing bluff on the west bank of Ammonite Creek, about 500 feet south of the road marking the northern boundary of the municipal golf course, and in about the center of the golf course, southwest of Fort Worth, Tarrant County, Texas. The bluff is about 10 feet high, and there are thin marl seams between the heavy limestone ledges, which are about 1.5 feet thick. This is only the lower part of the Duck Creek.

Sample number	Thickness (feet)	Description
240	0.2	Marl break 1 foot below the top and 9 feet above the base of the exposed section.
	3	Limestone beds, no sample.
239	0.2	Marl break 6 feet above the base.
	4	Limestone beds, no sample.
238	2	Base exposed, marly limestone.

Locality HTL-57.—Collected in June 1939 in a deep road cut on the east side of the U. S. Highway 77, just south of the bridge across the Red River, in Cooke County, Texas. This is an excellent exposure.

Sample number	Thickness (feet)	Description
296	10	Top of exposure. Marls, with a few thin limestones, grass-covered above.
295	5	Alternating thin limestones and marls, with the marls predominating.
294	5	Alternating thin limestones and marls, marls predominating.
293	5	Alternating thin limestones and thicker marls.
290	4	Thin limestone bed at the top, then 2 feet of marl with a heavy 2-foot limestone bed below.
291	6	Interbedded yellow-gray marls and limestones, just below the 2-foot limestone bed. The limestones are more abundant here than above.
292	5	Base of section exposed. Marls and limestones.

Locality HTL-60.—Collected in June 1939. The lower part of the Duck Creek formation is exposed in a low north-facing cliff on the south bank of a small stream, a short distance north of the road, 0.1 miles east of the bridge which crosses the creek, 0.9 miles east of Fink (locally called Georgetown), in Grayson County, Texas.

Sample number	Thickness (feet)	Description
300	0.7	Clay, top of section exposed.
	2.5	Limestone bed, no sample.
301	1	Clay, just below the heavy limestone bed.
302	1	Alternating thin limestones and marls.
303	1	Alternating limestones and marls, base of exposure.

The Duck Creek at this locality is composed of alternating heavy limestone beds and thin marls, with an abundance of the large ammonite *Desmoceras brazoensis*.

ACKNOWLEDGMENTS

The writer wishes to acknowledge the assistance of Dr. Carey Croneis, of the University of Chicago, under whose direction this study was completed. The field work, including the collection of samples and the measuring and zoning of the outcrops, was done by the writer with the assistance of her husband, Dr. Alfred R. Loeblich, Jr., and her father, Professor F. G. Tappan, of the University of Oklahoma. Dr. Loeblich also assisted the writer in the preparation of the material in the laboratory and made valuable suggestions at various times during the course of the work.

Illustrations are shaded camera lucida drawings by the writer.

TYPE SPECIMENS

All figured specimens, holotypes, paratypes and hypotypes, are to be deposited in the Cushman Collection at the Cushman Laboratory for Foraminiferal Research, Sharon, Massachusetts. Paratypes and hypotypes are also to be deposited at Walker Museum, University of Chicago, and in the Loeblich Collection at Tulane University, New Orleans. However, all types are temporarily to be kept in the Loeblich Collection, pending the completion of a monographic study of the Foraminifera of the Washita group, in which the catalogue numbers of the various collections will be published.

CONCLUSIONS

A total of 120 species has been found in the Duck Creek formation, representing 59 genera and 18 families. The family Lagenidae comprises over one-third of the total number of species recovered, with the Textulariidae and Buliminidae next in number of species represented.

The geologic ranges of five genera were extended downward into the Lower Cretaceous for the first time. These are *Ammobaculoides* and *Hastigerinella*, which had not previously been recorded below the Upper Cretaceous, and *Siphotextularia*, *Unicosiphonia* and *Stichocibicides*, not previously known below the Tertiary. One new genus, *Washitella*, with two new species, is described. There are 36 other new species, making a total of 38.

Twenty-nine of the previously described 82 species were originally described from Europe, three of these being here recorded for the first time from this continent. Twenty-eight of the previously described species are first recorded from the Duck Creek formation, so that their specific ranges within the Washita group are extended.

No index species are suggested here, as the ranges in the other formations of the Washita group are as yet incompletely known. The complete geologic ranges and zonal markers for the Washita group will be discussed in a forthcoming monograph on the

Foraminifera of the Washita group, by Dr. Alfred R. Loeblich and the writer.

An unusually large number of twinned specimens and freaks have been found, of both the calcareous and agglutinated types, only a few of which are illustrated. Such an occurrence in modern faunas would suggest a warm, shallow-water environment. It is hoped that more complete evidence as to the environment of the various formations of the Washita group at the time of their deposition can also be presented in the above mentioned monograph.

DESCRIPTION OF FORAMINIFERA

Family SACCAMMINIDAE

GENUS LAGENAMMINA Rhumbler, 1911

LAGENAMMINA PYRIFORMIS Tappan

Plate 77, figure 1a-2b

Lagenammina pyriformis TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 94, pl. 14, figs. 1a-2b.

Reophax ampullacea Brady, CHAPMAN, 1892, Royal Micr. Soc. Jour., p. 320, pl. 5, figs. 2a-b.

Test free, medium in size, consisting of a single globular to pyriform chamber with a narrow elongate neck and a basal spine similar in appearance to the neck; wall coarsely arenaceous, with a considerable amount of cement, cement generally chalky white, with an appearance like that of the walls of the Miliolidae and Ophthalmitidae occurring in this horizon; aperture at the end of the elongate neck. Length of hypotype in figure 1, 0.53 mm., breadth 0.24 mm., thickness 0.19 mm.; length of hypotype in figure 2, 1.07 mm., breadth 0.31 mm., thickness 0.26 mm.

Types.—Hypotypes from locality HTL-13, sample 119.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation. The Duck Creek specimens generally are not as much compressed as were those in the Grayson, and the aperture is rounded rather than elongate. These features may be due to the preservation, however.

Family REOPHACIDAE

Genus REOPHAX Montfort, 1808

REOPHAX DECKERI Tappan

Plate 77, figure 3

Reophax deckeri TAPPAN, 1940, Jour. Paleontol-

ogy, vol. 14, no. 2, p. 94, pl. 14, figs. 3a-b. *Reophax eckernex* VIEAUX, 1941, Jour. Paleontology, vol. 15, no. 6, p. 625, pl. 85, fig. 1.

Test free, medium-sized, elongate, flattened, periphery rounded; chambers elongate, arranged in a linear and occasionally slightly arcuate series, increasing in size quite rapidly, last chamber generally much larger than the preceding; sutures distinct, depressed; wall coarsely arenaceous, aperture at the end of a neck; color usually reddish. Length of hypotype 0.67 mm., breadth 0.22 mm., thickness 0.12 mm.

Types.—Hypotype from locality HTL-13, sample 116.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation.

REOPHAX MINUTA Tappan

Plate 77, figures 4a, b

Reophax minuta TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 94, pl. 14, figs. 4a, b.

Test free, small, flattened, periphery rounded and slightly lobulate; chambers short and broad, arranged in a linear series which is sometimes slightly arcuate, cham-

bers increasing gradually in size as added, generally collapsed centrally or subcentrally; sutures distinct, depressed, horizontal; wall medium to finely arenaceous; aperture terminal, elongate. Length of hypotype 0.45 mm., breadth 0.15 mm., thickness 0.08 mm.

Type.—Hypotype from locality HTL-13, sample 115.

Remarks.—This species was originally described from the Grayson formation, the range being here extended downward to include the Duck Creek formation. The Duck Creek specimens are slightly less compressed than those of the Grayson, although this feature may be due to the preservation.

Genus HAPLOSTICHE Reuss, 1861

HAPLOSTICHE TEXANA (Conrad)

Plate 77, figure 5

Nodosaria texana CONRAD, 1857, Mexican Boundary Survey, vol. 1, pt. 2, p. 159, pl. 14, fig. 4. *Haplostiche texana*, PLUMMER, 1931, Texas Univ. Bull. 3101, p. 124, pl. 15, fig. 1.

Cribratrina texana, SAMPLE, 1932, Am. Midland Naturalist, vol. 13, p. 319.

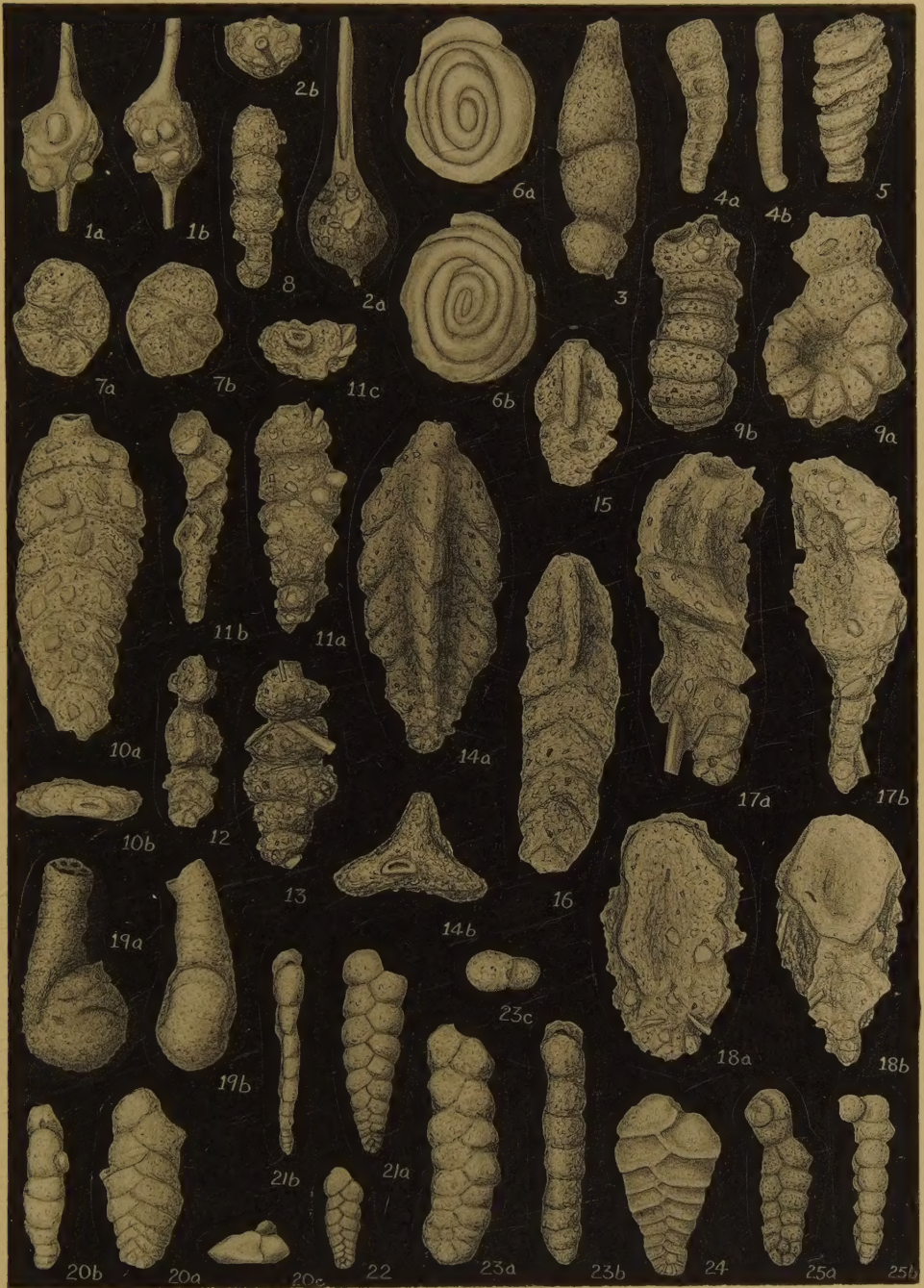
Haplostiche texana, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 95, pl. 14, figs. 5a, b.

Test large, broad, uniserial, roughly circular in section; chambers numerous, low, in-

EXPLANATION OF PLATE 77

Families Saccamminidae to Textulariidae

- FIGS. 1, 2—*Lagenammina pyriformis* Tappan. 1a, b, $\times 53$. 2a, Side view, 2b, top view, $\times 35$. (p. 479)
 3—*Reophax deckeri* Tappan. Side view, $\times 53$. (p. 479)
 4—*Reophax minuta* Tappan. 4a, Side view, 4b, edge view, $\times 53$. (p. 480)
 5—*Haplostiche texana* (Conrad). $\times 10$. (p. 480)
 6—*Ammodiscus gaultinus* Berthelin. Side views, $\times 76$. (p. 481)
 7—*Haplophragmoides concava* (Chapman). Side views, $\times 53$. (p. 481)
 8—*Ammobaculites variabilis* Tappan. Side view, $\times 35$. (p. 482)
 9—*Ammobaculites goodlandensis* Cushman and Alexander. 9a, Side view, 9b, edge view, $\times 20$. (p. 481)
 10—*Flabellammina longiuscula* Alexander and Smith. 10a, Side view, 10b, top view, $\times 17$. (p. 482)
 11–13—*Flabellammina rugosa* Alexander and Smith. Topotypes. 11a, Side view, 11b, edge view, 11c, top view, 12, 13, side views, $\times 20$. (p. 482)
 14—*Frankeina acutocarinata* Alexander and Smith. 14a, Side view of topotype, 14b, top view, $\times 17$. (p. 483)
 15, 16—*Frankeina incerta* Alexander and Smith. Side views, $\times 17$. (p. 483)
 17, 18—*Frankeina insolita* Alexander and Smith. Topotypes. 17a, 18a, Side views, 17b, 18b, edge views, $\times 17$. (p. 483)
 19—*Lituola serpulula* Tappan, n. sp. 19a, Side view of holotype, 19b, edge view, $\times 17$. (p. 484)
 20—*Spiroplectammina acostai* Tappan, n. sp. 20a, Side view of holotype, 20b, edge view, 20c, top view, $\times 76$. (p. 484)
 21, 22—*Spiroplectammina longa* Lalicker. 21a, Side view, 21b, edge view, 22, side view, $\times 35$. (p. 484)
 23—*Spiroplectammina ammovitrea* Tappan. 23a, Side view, 23b, edge view, 23c, top view, $\times 76$. (p. 484)
 24—*Spiroplectammina nuda* Lalicker. Side view, $\times 76$. (p. 485)
 25—*Ammobaculoides* sp. 25a, Side view, 25b, edge view, $\times 76$. (p. 485)



Tappan, Lower Cretaceous (Duck Creek) Foraminifera

creasing gradually in diameter; sutures distinct, depressed, generally straight; wall very coarsely arenaceous, very thick, labyrinthic; aperture cribrate, terminal. Length of hypotype 2.28 mm., breadth 1.29 mm.

Type.—Hypotype from locality HTL-13, sample 112.

Remarks.—*Haplostiche texana* (Conrad) has been recorded throughout the Washita group as well as from the underlying Goodland and Edwards limestones of the Fredericksburg group and the Glen Rose limestone of the Trinity group. It is best developed in the middle and upper Washita, being very abundant in some horizons of the Paw Paw formation of northern Texas and the Del Rio clay of southern Texas. It is generally rare in the Duck Creek formation and the specimens poorly preserved, crushed and twisted, as is the hypotype. The species is distinguished by its large straight test, labyrinthic wall and cribrate aperture.

Family AMMODISCIDAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS GAULTINUS Berthelin

Plate 77, figures 6a, b

Ammodiscus gaultinus BERTHELIN, 1880, Geol. Soc. France, Mém., sér. 3, t 1, no. 5, p. 19, pl. 1 (24), figs. 3a, b.

Ammodiscus gaultinus, EGGER, 1899, K. bayer. Akad. Wiss. München, Abh., Cl. 2, vol. 21, p. 16, pl. 1, figs. 1-3, 8-9, 30-31.

Ammodiscus gaultinus, CHAPMAN, 1917, Geol. Survey West Australia Bull. 72, p. 18, pl. 1, fig. 8.

Ammodiscus gaultinus, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 95, pl. 14, figs. 6a-c.

Test medium-sized, discoidal, irregularly planispirally coiled, periphery rounded; proloculum slightly ovate, tubular second chamber increasing gradually in size, occasionally overlapping the preceding coil somewhat; wall very finely arenaceous, with much cement, surface irregular; aperture formed by the open end of the tubular chamber. Maximum diameter of hypotype 0.31 mm., minimum diameter 0.25 mm., thickness 0.07 mm.

Type.—Hypotype from locality HTL-13, sample 119.

Remarks.—This species has been recorded from the Grayson formation of Texas, and the range is here extended to include the Duck Creek formation. The species was

originally described from France and also occurs in Germany and western Australia.

Family LITUOLIDAE

Subfamily HAPLOPHRAGMININAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES CONCAVA (Chapman)

Plate 77, figures 7a, b

Trochammina concava CHAPMAN, 1892, Royal Micr. Soc. Jour., p. 327, pl. 6, figs. 14a, b.

Haplophragmoides concava, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 95, pl. 14, figs. 7a-c.

Test small, planispiral, involute, compressed, periphery subacute; chambers increasing gradually in size, five or six usually visible; sutures fairly distinct, slightly depressed; wall finely arenaceous; aperture simple, at the base of the apertural face of the last-formed chamber. Greatest diameter of hypotype 0.29 mm., least diameter 0.24 mm., thickness 0.04 mm.

Type.—Hypotype from locality HTL-13, sample 120.

Remarks.—This species was originally described from the Gault of England and ranges throughout the Washita group of southern Oklahoma and northern Texas. Many of the specimens are flattened and distorted.

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES GOODLANDENSIS

Cushman and Alexander

Plate 77, figures 9a, b

Ammobaculites goodlandensis CUSHMAN and ALEXANDER, 1930, Cushman Lab. Foram. Research Contr., vol. 6, p. 8, pl. 2, figs. 7, 8.

Ammobaculites goodlandensis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 96, pl. 14, figs. 8a-9.

Test free, large, early portion coiled, last two or three chambers uncoiled, deeply umbilicate, periphery broad and truncate and angularly lobulate; chambers numerous, 10 occurring in the last volution of the coiled portion of the hypotype, chambers inflated centrally, giving the test a nodose appearance; sutures much depressed but otherwise not distinct; wall coarsely arenaceous, frequently incorporating the tests of smaller Foraminifera, such as *Globigerina*; aperture terminal. Length of hypotype 1.44 mm.,

breadth of coiled portion 0.98 mm., breadth of last chamber of uncoiled portion 0.62 mm., thickness through last chamber 0.62 mm.

Type.—Hypotype from locality HTL-13, sample 116.

Remarks.—This species was described from the Goodland formation of the Fredericksburg group and also ranges throughout the Washita.

AMMOBACULITES VARIABILIS Tappan
Plate 77, figure 8

Ammobaculites variabilis TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 97, pl. 14, figs. 12a, b.

Test free, medium-sized, elongate, early portion coiled and compressed, later uniserial and more nearly rounded in section, periphery rounded; chambers numerous, five in the coiled portion and four in the uniserial portion of the figured hypotype, increasing gradually in size throughout the coiled stage, the first uniserial chambers much larger than the preceding chambers, then the increase is again gradual in the remainder of the test, chambers inflated centrally although irregularly; sutures distinct and depressed in the early portion, and depressed but less distinct in the uniserial stage; wall finely arenaceous in the early part, coarsely arenaceous later and frequently incorporating tests of *Globigerina* and other small foraminifera; aperture terminal, elongate, at the end of a thick, short neck. Length of hypotype 0.73 mm., breadth of last chamber 0.18 mm., greatest diameter of coiled portion 0.13 mm., greatest thickness through coiled stage 0.06 mm., greatest thickness of uniserial portion 0.17 mm.

Type.—Hypotype from locality HTL-13, sample 116.

Remarks.—This species was originally described from the Grayson formation and the range is here extended to include the Duck Creek formation.

Genus FLABELLAMMINA Cushman, 1928
FLABELLAMMINA LONGIUSCULA
Alexander and Smith
Plate 77, figures 10a, b

Flabellammina longiuscula ALEXANDER and SMITH, 1932, Jour. Paleontology, vol. 6, no. 4, p. 303, pl. 45, figs. 13, 16; pl. 46, fig. 1.

Test free, large, thick, moderately com-

pressed, early portion coiled, later uniserial, periphery rounded; chambers numerous, coiled at first, then uniserial with equitant chambers increasing very gradually in size, so that the margins of the test are nearly straight; sutures indistinct in the early part, later slightly depressed; wall coarsely arenaceous, with coarse grains embedded in a ground mass of finer material; aperture terminal, elliptical, at the end of a short, broad neck. Length of hypotype 2.60 mm., breadth 0.99 mm., thickness 0.34 mm.

Type.—Hypotype from locality HTL-13, sample 116.

Remarks.—This species was originally described from the Duck Creek formation in a road cut at the north end of Rogers Avenue, 0.38 miles north of the campus of Texas Christian University, in Fort Worth, Tarrant County, Texas, but the type locality has since been destroyed. This species ranges from the Duck Creek through the Fort Worth and Denton formations of the Washita group.

FLABELLAMMINA RUGOSA Alexander
and Smith
Plate 77, figures 11a–13

Flabellammina rugosa ALEXANDER and SMITH, 1932, Jour. Paleontology, vol. 6, no. 4, p. 302, pl. 45, figs. 6–9, text fig. 1.

Test free, medium-sized, elongate, somewhat compressed, periphery rounded but irregular in outline; chambers coiled in the early portion although this cannot always be told externally, later chambers uncoiled, very slightly arched, nearly as long as broad; sutures generally indistinct, sometimes slightly depressed in the later portions of the test; wall coarsely arenaceous, with *Inoceramus* prisms and tests of *Globigerina* and other small foraminifera frequently incorporated; aperture terminal, slightly elongate. Length of topotype in figure 11, 1.38 mm., breadth 0.64 mm., greatest thickness 0.37 mm.; length of topotype in figure 12, 1.16 mm., breadth 0.38 mm.; length of topotype in figure 13, 1.53 mm., breadth 0.62 mm.

Types.—Topotypes from locality HTL-60, sample 303.

Remarks.—This species is known only from the Duck Creek formation of the Washita group, although it has also been recorded from the Upper Cretaceous Austin chalk. It

is one of the most abundant species found in the Duck Creek formation.

Genus *FRANKEINA* Cushman and Alexander, 1929

FRANKEINA ACUTOCARINATA Alexander and Smith

Plate 77, figures 14a, b

Frankeina acutocarinata ALEXANDER and SMITH, 1932, Jour. Paleontology, vol. 6, no. 4, p. 307, pl. 47, figs. 1, 6.

Test free, large, elongate, flattened and planispiral in the early part, later uniserial and triangular in section, periphery angular in the early part, later becoming rounded; planispiral chambers flattened, comprising only a small portion of the test, later part uniserial, chambers increasing rapidly in size, sides deeply excavated with angles sharp at first, later rounded, chambers strongly recurved at the angles; sutures generally indistinct in the coiled part, slightly depressed in the uniserial part but sometimes indistinct except at the angles of the test; wall medium to coarsely arenaceous, generally smoothly finished; aperture elongate, at the end of a neck. Length of topotype 2.67 mm., breadth 1.14 mm.

Type.—Topotype from locality HTL-60, sample 303.

Remarks.—This is a very large species and is frequently quite abundant in the Duck Creek formation. It is limited in range to the lower Washita, having been recorded also from the Fort Worth, Denton and Weno formations.

FRANKEINA INCERTA Alexander and Smith

Plate 77, figures 15, 16

Frankeina incerta ALEXANDER and SMITH, 1932, Jour. Paleontology, vol. 6, no. 4, p. 308, pl. 47, fig. 4.

Test free, large, early portion flattened, planispiral, later uniserial and compressed, near the apertural end becoming triangular in section, although the new angle is generally not as high as the other angles, sides only moderately excavated, periphery rounded; chambers numerous, uniserial chambers arched and increasing very gradually in size so that the sides of the test are nearly straight; sutures not distinct although occasionally slightly depressed; wall coarsely

arenaceous; aperture terminal, elongate, at the end of a short, broad neck. Length of hypotype in figure 16, 2.49 mm., breadth 0.77 mm., thickness through Flabellamine stage 0.28 mm., thickness through triangular part 0.34 mm.; length of hypotype in figure 15, 1.14 mm., breadth 0.70 mm.

Types.—Hypotypes from locality HTL-13, sample 116.

Remarks.—This species was described from the Fort Worth formation, and was also recorded from the Denton. The range is here extended downward to include the Duck Creek formation. The length of the Flabellamine stage, before the addition of the third angle, is quite variable in the Duck Creek specimens, as shown in the two examples figured.

FRANKEINA INSOLITA Alexander and Smith

Plate 77, figures 17a-18b

Frankeina insolita ALEXANDER and SMITH, 1932, Jour. Paleontology, vol. 6, no. 4, p. 308, pl. 47, figs. 2, 3.

Test free, large, early portion planispiral and compressed, then becoming abruptly thicker and quadrate in section, or somewhat irregularly flattened, sides of test in triangular or quadrate portion generally excavated, periphery in the early part fairly sharp, later rounded; chambers numerous, small in planispiral portion, increasing rapidly in size in the early part of the uniserial stage and then more gradually, so that the sides in the latter one-half of the test are nearly straight; sutures obscure, somewhat more distinct in the planispiral part than later; wall coarsely arenaceous, with *Inoceramus* prisms frequently incorporated; aperture terminal, somewhat rounded. Length of topotype in figure 18, 2.00 mm., breadth 1.20 mm., thickness 1.01 mm.; length of topotype in figure 17, 2.60 mm., greatest breadth 1.07 mm., thickness in the early portion of the test 0.28 mm., thickness near aperture 0.62 mm.

Types.—Topotype of figure 18, from sample 303, that of figure 17 from sample 301, both from locality HTL-60.

Remarks.—This is one of the most variable species of *Frankeina* in this horizon and is both large and abundant. It is known only from the Duck Creek formation.

Genus LITUOLA Lamarck, 1804
LITUOLA SERPULA Tappan, n. sp.
Plate 77, figures 19a, b

Test free, large, thick, early portion coiled, umbilicate, later uniserial, periphery broadly rounded; early chambers planispiral, about eight in the coiled portion of the holotype, chambers quite thick, later chambers uniserial and circular in cross section, smaller in diameter than those of the coiled portion; sutures straight, indistinct and very slightly depressed; wall coarsely arenaceous, with coarse grains embedded in a ground mass of finer material, surface smoothly finished, wall labyrinthic in the interior; aperture multiple and terminal. Length of holotype 1.70 mm., breadth of coiled portion 0.86 mm., greatest thickness through coiled portion 0.62 mm., breadth at apertural end 0.41 mm.

Type.—Holotype from locality HTL-57, sample 290.

Remarks.—This species differs from *L. taylorensis* Cushman and Waters in the comparatively greater thickness of the coiled portion, the cylindrical uniserial portion, and the much less distinct sutures. *L. serpula* is also smaller, being only about one-third the size of *L. taylorensis*.

Family TEXTULARIIDAE

Subfamily SPIROPLECTAMMININAE

Genus SPIROPLECTAMMINA Cushman, 1927
SPIROPLECTAMMINA ACOSTAI
Tappan, n. sp.
Plate 77, figures 20a–c

Test small, broad and elongate, periphery rounded; chambers coiled at first, later biserial with low chambers, which then increase in height, but very slowly in breadth so that the sides of the test are nearly parallel, test also of nearly constant thickness throughout, the early part being only slightly less in thickness; sutures indistinct in the coiled portion, distinct and depressed in the biserial part; wall finely arenaceous, with considerable cement, smoothly finished; aperture an arch at the base of the last-formed chamber. Length of holotype 0.30 mm., breadth 0.15 mm., thickness 0.07 mm.

Type.—Holotype from locality HTL-34, sample 211.

Remarks.—This species differs from *S. longa* Lalicker in the broader test, more angular sutures, and greater thickness throughout. It differs from *S. nuda* Lalicker in lacking the limbate sutures and in the more nearly parallel sides and similar thickness throughout, as *S. nuda* is much more flaring, especially in the early portion. This species is named in honor of Dr. José T. Acosta, Havana, Cuba.

SPIROPLECTAMMINA AMMOVITREA Tappan
Plate 77, figures 23a–c

Spiroplectammina ammovitrea TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 97, pl. 14, figs. 13a, b.

Test tiny, elongate, slender, sides nearly parallel for most of the biserial length, test slightly broader across coiled portion than across later biserial portion, but of approximately same thickness throughout, periphery broadly rounded, very slightly lobulate; chambers numerous, five visible in coiled portion of figured hypotype, chambers of biserial portion low at first, increasing gradually in height; sutures fairly distinct, depressed in later portions; wall medium to finely arenaceous, with considerable cement, rather smoothly finished; aperture a low arch at the base of the last formed chamber. Length of hypotype 0.50 mm., breadth 0.13 mm., thickness 0.08 mm.

Type.—Hypotype from locality HTL-60, sample 303.

Remarks.—This species was originally described from the Grayson formation and the range is here extended downward to include the Duck Creek formation. The Duck Creek specimens seem to be slightly more finely arenaceous than those of the Grayson, but this may be due to environmental factors. The specimens agree closely in size and proportions. *S. ammovitrea* Tappan seems to be rare wherever found, although it ranges throughout the Washita group.

SPIROPLECTAMMINA LONGA Lalicker
Plate 77, figures 21a–22

Spiroplectammina longa LALICKER, 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 3, pl. 1, figs. 4, 5.

Spiroplectammina longa, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 97, pl. 14, figs. 14a, b.

Test small, elongate, flattened, periphery subacute and slightly lobulate; early chambers planispiral, then biserial, with chambers at first low and then becoming higher, increasing very gradually in breadth so that the test flares very little or may even have parallel sides; sutures distinct, thickened and slightly depressed between the later chambers, slightly oblique at first, later nearly horizontal; wall finely arenaceous, smoothly finished; aperture an arch at the base of the last-formed chamber. Length of hypotype in figure 21, 0.81 mm., breadth 0.24 mm., greatest thickness 0.12 mm.; length of hypotype in figure 22, 0.40 mm., breadth 0.16 mm.

Types.—Hypotypes from locality HTL-13, sample 119.

Remarks.—This species ranges throughout the Washita group and is common in the Duck Creek formation.

SPIROPLECTAMMINA NUDA Lalicker

Plate 77, figure 24

Spiroplectammina nuda LALICKER, 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 4, pl. 1, figs. 6, 7.

Spiroplectammina nuda, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 98, pl. 14, figs. 15a-16.

Test small, flattened, flaring gradually, thickest centrally, periphery subacute, giving a diamond-shaped cross section; chambers numerous, coiled at first, later biserial, depressed centrally; sutures limbate and raised, straight, nearly horizontal; wall finely arenaceous, with considerable cement, smoothly finished; aperture a low arch at the base of the last-formed chamber. Length of hypotype 0.33 mm., breadth 0.18 mm., thickness 0.11 mm.

Type.—Hypotype from locality HTL-13, sample 113.

Remarks.—This species was originally described from the Fort Worth and Denton formations and later recorded also from the Grayson. The range is here extended downward to include the Duck Creek formation. The specimens in the lower part of the Washita group are generally rare and smaller and less well developed than those of the upper Washita.

Genus AMMOBACULOIDES Plummer, 1932

AMMOBACULOIDES sp.

Plate 77, figures 25a, b

Test tiny, elongate, early portion coiled, later biserial with chambers increasing gradually in size and periphery subacute and lobulate, then uniserial, with test of smaller diameter and chambers nearly circular in cross-section; chambers numerous, increasing very gradually in height; sutures distinct and depressed, especially in the biserial portion; wall finely arenaceous, smoothly finished; aperture terminal, rounded. Length of specimen 0.30 mm., greatest breadth of biserial portion 0.10 mm., greatest thickness of biserial portion 0.07 mm., greatest breadth of uniserial portion 0.08 mm., greatest thickness of uniserial portion, 0.08 mm.

Type.—Locality HTL-57, sample 290.

Remarks.—The genus *Ammobaculoides* has been known only from the Upper Cretaceous and the generic range is here extended into the Lower Cretaceous. The present species differs from *A. navarroensis* Plummer in the much smaller and nearly parallel-sided test, very gradually enlarging biserial chambers, greater thickness of the test and more circular cross section of the uniserial chambers. No specific name is proposed, as the species is thus far represented by a single specimen.

Subfamily TEXTULARIINAE

Genus TEXTULARIA Defrance, 1824

TEXTULARIA RIOENSIS Carsey

Plate 78, figures 1a-4

Textularia rioensis CARSEY, 1926, Texas Univ. Bull. 2612, p. 24, pl. 5, fig. 12.

Textularia conica d'Orbigny. CARSEY, 1926, Texas Univ. Bull. 2612, p. 23, pl. 7, fig. 1.

Textularia rioensis, PLUMMER, 1931, Texas Univ. Bull. 3101, p. 128, pl. 8, fig. 8.

Textularia rioensis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 98, pl. 15, figs. 1a-2b.

Test medium-sized, flaring in outline, periphery broadly rounded; chambers numerous, biserially arranged, increasing in breadth and height fairly rapidly so that the early portion of the test is somewhat conical, later increasing more gradually; sutures distinct, depressed; wall of medium-sized grains, occasionally coarsely arenaceous and rough-textured, and at other times smoothly finished; aperture a low arch at the base of the

last-formed chamber. Length of hypotype in figure 1, 0.90 mm., breadth 0.41 mm., thickness 0.39 mm.; length of hypotype in figure 2, 0.43 mm., breadth 0.21 mm.; length of plastogamic hypotype in figure 3, 0.69 mm.; length of hypotype in figure 4, 0.49 mm., breadth 0.26 mm.

Types.—Hypotypes of figures 1, 2 and 4 from sample 120, hypotype of figure 3 from sample 116, all from locality HTL-13.

Remarks.—This is one of the most common species found in the Washita group and ranges throughout in abundance. It is also quite variable in outline, but series showing gradations between the variations can easily be selected. There are also occasional freaks and twinned specimens such as that shown in figure 3.

TEXTULARIA WASHITENSIS Carsey

Plate 78, figures 5a-9

Textularia washitensis CARSEY, 1926, Texas Univ. Bull. 2612, p. 34, pl. 7, fig. 6.

Textularia washitensis, PLUMMER, 1931, Texas Univ. Bull. 3101, p. 127, pl. 8, fig. 5.

Textularia washitensis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 98, pl. 15, figs. 3-4b.

Test large, broad, elongate, biserial throughout, periphery subacute; chambers numerous, at first increasing fairly rapidly in breadth, producing a flaring test, then increasing less rapidly so that the sides of the test become subparallel, chambers also increase in height, may be either gently convex or collapsed centrally; sutures distinct, depressed, usually giving a somewhat lobulate periphery, but in some specimens when the chambers are collapsed the sutures are left slightly elevated; wall of medium-sized grains, usually smoothly finished; aperture a low arch at the base of the last-formed chamber. Length of hypotype of figure 5, 1.21 mm., breadth 0.54 mm., thickness 0.29 mm.; length of hypotype of figure 6, 1.12 mm., breadth 0.43 mm.; length of hypotype of figure 7, 1.19 mm., breadth 0.42 mm.; length of hypotype of figure 8, 0.81 mm., breadth 0.48 mm., thickness 0.26 mm.

Types.—Hypotypes of figures 5 and 8 from locality HTL-57, sample 296; hypotypes of figures 6 and 9 from locality HTL-13, sample 114; hypotype of figure 7 from locality HTL-38, sample 224.

Remarks.—This species occurs abundantly throughout the Washita group. However, specimens from the lower Washita, as in the Duck Creek, are perhaps better developed than later forms, as the specimens are unusually long and broad. Also the tests generally show less collapse of the chambers and have depressed sutures, a more flaring test, and a more angular periphery. Those in the upper Washita show definitely collapsed chambers and the resultant higher sutures, and a more parallel-sided test and blunt periphery. Some gradation may be observed in all of the formations, as is shown by the specimens figured.

TEXTULARIA DUCKCREEKENSIS

Tappan, n. sp.

Plate 78, figures 10a-c

Test of medium size, considerably flattened, periphery subacute; chambers numerous, biserially arranged, increasing gradually in height and breadth so that the test flares slightly, chambers may be very faintly depressed centrally; sutures distinct, raised and limbate; wall arenaceous, composed of medium-sized grains, surface rough; aperture slightly elongate, apparently in the face of the last-formed chamber, rather than at its base. Length of holotype 0.70 mm., breadth 0.35 mm., thickness 0.10 mm.

Type.—Holotype from locality HTL-27, sample 169.

Remarks.—This species is somewhat similar in appearance to *T. washitensis* Carsey but differs in the much more compressed test and less tapering of the initial portion, comparatively higher chambers, rougher appearance, and in the character of the aperture.

Genus SIPHOTEXTULARIA Finlay, 1939

SIPHOTEXTULARIA SUBCRETACEA

Tappan, n. sp.

Plate 78, figures 11a-c

Test medium-sized, elongate, quadrate in section, biserial throughout, sides excavated, periphery sharply keeled; chambers increase very gradually in size so that the sides of the test are subparallel, sutures slightly thickened but flush with the surface and indistinct; wall medium to coarsely arenaceous, with considerable cement; aperture in the

face of the last formed chamber, surrounded by a lip. Length of holotype 0.66 mm., breadth 0.26 mm., greatest thickness 0.22 mm., thickness through last chamber 0.17 mm.

Types.—Holotype from locality HTL-27, sample 169.

Remarks.—The genus *Siphotextularia* Finlay has been known previously only from the Tertiary and Recent. The generic range is here extended downward into the Lower Cretaceous. The present species is apparently a very primitive member of the genus but agrees in the quadrangular section and the character of the aperture. The typical *Siphotextularia* has the aperture at the end of a short tubular extension in the apertural face, somewhat above the basal margin. The aperture of *S. subcretacea* is in the same position, but instead of a definite tubular neck has only a raised, liplike area surrounding the aperture.

Siphotextularia subcretacea differs from *S. wairoana* Finlay in having a slightly larger test, keeled margins, a longer aperture with a surrounding lip rather than a tubular process, and in possessing less distinct sutures.

Genus BIGENERINA d'Orbigny, 1826

BIGENERINA WINTONI Cushman

and Alexander

Plate 78, figures 12–16

Bigenerina wintoni CUSHMAN and ALEXANDER, 1930, Cushman Lab. Foram. Research Contr., vol. 6, p. 9, pl. 2, figs. 15a, b.

Bigenerina wintoni, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 99, pl. 15, figs. 5a, b.

Test large, elongate, flattened, early portion biserial, periphery sharply truncate, later uniserial and periphery rounded; biserial chambers slightly collapsed centrally and increase gradually in size so that the sides of the test are subparallel, uniserial chambers much larger and rounded in section; sutures generally distinct, oblique, thickened and raised in the biserial portion, straight and depressed in the uniserial portion, the amount of depression varying, so that the uniserial portion may be cylindrical, or constricted at the sutures and beadlike; wall arenaceous, composed of medium-sized grains, surface rough; aperture terminal, rounded. Length of hypotype in figure 12, 1.91 mm., greatest breadth of biserial portion 0.30 mm., breadth of uniserial portion

0.41 mm.; length of topotype in figure 13, 0.53 mm.; length of hypotype in figure 14, 0.27 mm., breadth 0.19 mm., thickness 0.08 mm.; length of topotype in figure 15, 0.69 mm., breadth 0.17 mm.; length of topotype in figure 16, 1.20 mm., breadth of biserial portion 0.24 mm., thickness of biserial portion 0.16 mm., breadth of uniserial portion 0.19 mm., thickness of uniserial portion 0.20 mm.

Types.—Hypotype of figure 12 from sample 118, hypotype of figure 114 from sample 121, both from locality HTL-13; topotypes of figures 13, 15 and 16 all from locality HTL-27, sample 169.

Remarks.—*Bigenerina wintoni* Cushman and Alexander ranges throughout the Washita group but is rare in the upper formations, while it is abundant in the Duck Creek formation. There is considerable variation in the length of the biserial and uniserial stages, as well as in the character of the uniserial portion. These variations are shown in the figured specimens and may represent the microspheric and megalospheric generations. The specimens in the upper Washita show poor development of the uniserial stage, and the uniserial chambers are collapsed centrally in some specimens, rather than cylindrical or beadlike.

Family VERNEUILINIDAE

Genus TRITAXIA Reuss, 1860

TRITAXIA PLUMMERAE Cushman

Plate 78, figures 17–21

Tritaxia plummerae CUSHMAN, 1936, Cushman Lab. Foram. Research Spec. Pub. 6, p. 3, pl. 1, figs. 7a, b; 1937, idem, Spec. Pub. 7, p. 24, pl. 3, figs. 12–15.

Tritaxia pyramidata Reuss; PLUMMER, 1931, Texas Univ. Bull. 3101, p. 133, pl. 10, figs. 18, 19, 21 (not fig. 20).

Test, large, thick, triangular, triserial at first with flat or very slightly concave sides and sharp angles, later with one or two uniserial chambers, which are rounded in section; chambers increase fairly rapidly in the early part of the test until the approximate adult dimensions are reached, then increase more slowly so that the sides are nearly straight for most of the length of the test, uniserial chambers much larger in size and subglobular; sutures oblique, generally indistinct, occasionally slightly depressed; wall finely arenaceous, smoothly finished;

aperture a low arch at the base of the last-formed chamber during the triserial development, then becoming terminal and rounded in the uniserial chambers. Length of megalospheric topotype in figure 19, 0.78 mm., breadth 0.53 mm.; length of microspheric topotype in figure 18, 1.38 mm., breadth 0.53 mm.; length of topotype in figure 21, 1.34 mm., breadth 0.43 mm.; length of twinned specimen in figure 20, 1.10 mm.; length of megalospheric hypotype in figure 17, 0.94 mm., breadth 0.62 mm.

Types.—Topotypes of figures 18, 19 and 21 from locality HTL-42, sample 240; hypotypes of figure 20 from sample 113, and of figure 17 from sample 121, both from locality HTL-13.

Remarks.—This species is known only from the Duck Creek and Fort Worth formations of the lower Washita and is quite abundant in the samples where it occurs. There is some variation in the degree of development of the uniserial stage, possibly those with widely flaring triserial tests and poor uniserial development being the megalospheric individuals, while the microspheric form generally possesses a less flaring triserial portion and two or three uniserial chambers.

Plummer, in referring this species to *Tritaxia pyramidata* Reuss, illustrated four specimens, one of which showed a well-de-

veloped biserial stage, but no uniserial chambers. According to Plummer (1931, p. 134),

A rare development in tests of this species in the Duck Creek formation is the loss of one row of chambers, thus giving rise to a dimorphous form that changes from triserial to biserial.

Although the types have not been examined by the present writer, it is very probable that the biserial specimens are *Gaudryina alexanderi* Cushman rather than *Tritaxia plummerae* Cushman, as the two species occur together and are of similar size. *T. plummerae* differs in the absence of the biserial stage and in the more rounded angles of the test. The sutures are slightly depressed, while they are thickened in *G. alexanderi* and not depressed. Furthermore, the wall of *T. plummerae* is more finely arenaceous and more smoothly finished.

Genus GAUDRYINA d'Orbigny, 1839

GAUDRYINA ALEXANDERI Cushman

Plate 78, figures 22–27

Gaudryina alexanderi CUSHMAN, 1936, Cushman Lab. Foram. Research Spec. Pub. 6, p. 6, pl. 1, figs. 13a, b; 1937, idem, Spec. Pub. 7, p. 35, pl. 4, fig. 13.

Tritaxia pyramidata Reuss (part). PLUMMER 1931, Texas Univ. Bull. 3101, p. 133, pl. 10, fig. 20.

Test large, triangular and triserial at the base, periphery of triserial portion sharply

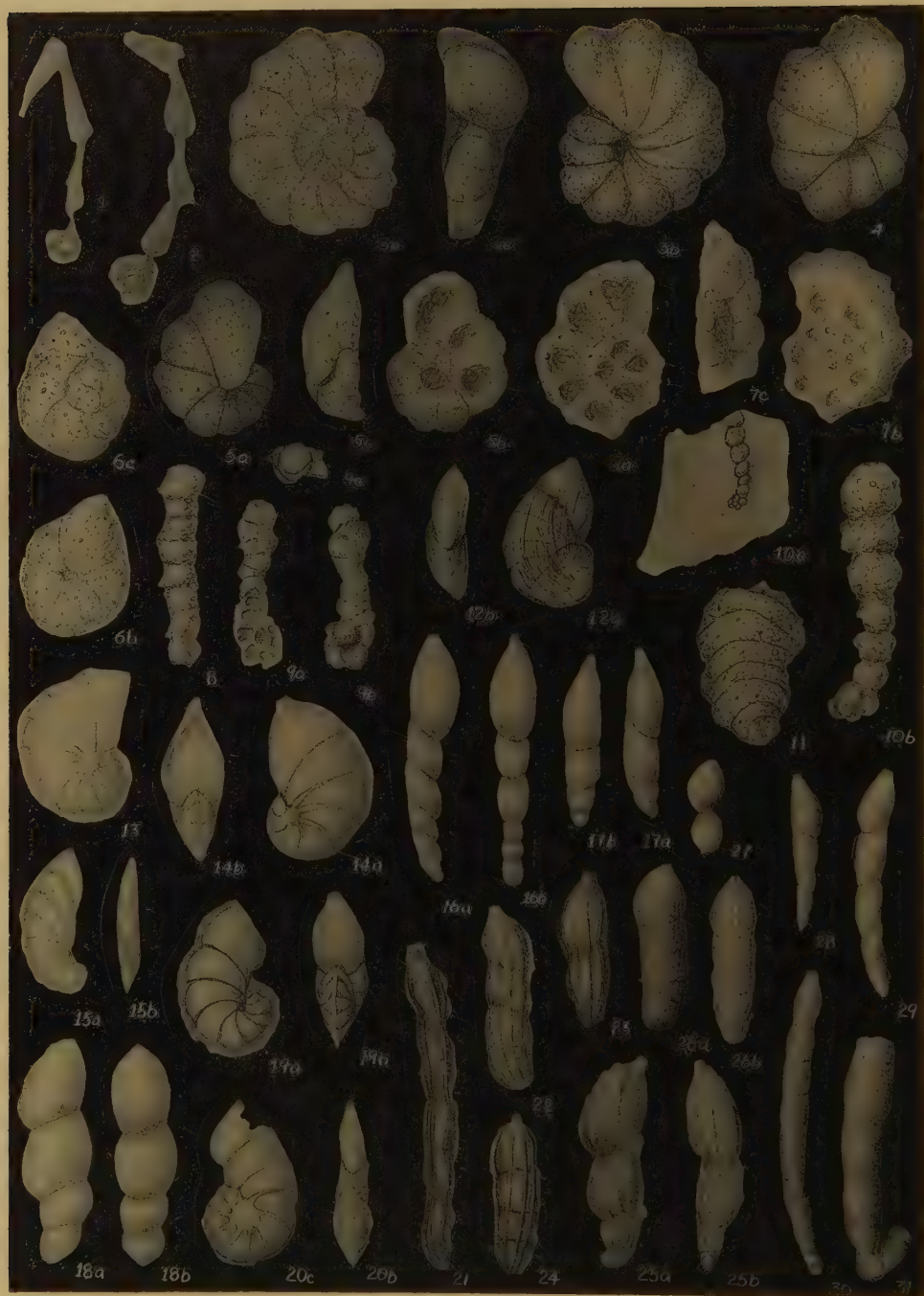
EXPLANATION OF PLATE 78

Families Textulariidae to Ophthalmitidae

- FIGS. 1–4—*Textularia rioensis* Carsey. 1a, 2a, 4, Side views, 1b, 2b, edge views, $\times 35$. 3, Plastogamic individual, $\times 20$. (p. 485)
- 5–9—*Textularia washitensis* Carsey. 5a, 6–9, Side views, 5b, edge view, $\times 20$. 5c, top view, $\times 27$. 9, Plastogamic individual. (p. 486)
- 10—*Textularia duckcreekensis* Tappan, n. sp. 10a, Side view of holotype, 10b, edge view, 10c, top view, $\times 35$. (p. 486)
- 11—*Siphotextularia subcretacea* Tappan, n. sp. 11a, Side view of holotype, 11b, edge view, 11c, top view, $\times 35$. (p. 486)
- 12–16—*Bigennerina wintoni* Cushman and Alexander. 12, 14, Hypotypes, 13, 15, 16, topotypes 12–16a, Side views, 16b, edge view, $\times 35$. (p. 487)
- 17–21—*Tritaxia plummerae* Cushman. 17, Side view of hypotype, $\times 27$. 18a, 19, 21, Side views of topotypes, 18b, top view, 20, side view of plastogamic hypotype, $\times 20$. (p. 487)
- 22–27—*Gaudryina alexanderi* Cushman. 22, 23, 25, 26, Hypotypes, 24, 27, topotypes. 23c and 26c, Top views, other views from the side, 22, 26, 27 show uniserial development, $\times 27$. (p. 488)
- 28, 29—*Gaudryina subcretacea* Cushman. Side views of topotypes, $\times 27$. (p. 490)
- 30—*Gaudryinella delrioensis* Plummer. Side view, $\times 76$. (p. 490)
- 31, 32—*Gaudryinella irregularis* Tappan, n. sp. 31, Side view of holotype. 32, Side view of paratype, $\times 76$. (p. 490)
- 33—*Quinqueloculina minima* Tappan, n. sp. Side views of holotype, $\times 76$. (p. 490)
- 34, 35—*Ophthalmitidium adhaerens* Tappan, n. sp. 34a, Side view of holotype, 34b, edge view, $\times 57$, 35, side view of paratype, $\times 76$. (p. 491)
- 36, 37—*Ophthalmitidium minima* Tappan, n. sp. 36, Side view of paratype, 37a, side view of holotype, 37b, edge view, $\times 57$. (p. 491)



Tappan, Lower Cretaceous (Duck Creek) Foraminifera



Tappan, Lower Cretaceous (Duck Creek) Foraminifera

angular and sides excavated, later biserial and flattened, biserial portion convex on the side where the third angle formerly appeared, concave on the opposite side, periphery subacute, in a few specimens there may also be one or more terminal, rounded uniserial chambers; chambers increase rapidly in size at first, so that the base of the triserial portion flares widely, then the increase is gradual throughout the remainder of the test, breadth is decreased where the third series of chambers is lost and the biserial stage begins, and also where uniserial development begins in the few specimens possessing such development; sutures generally indistinct in triserial portion of test, but depressed and distinct in the biserial and uniserial stages; wall arenaceous, composed of medium-sized grains, with considerable cement and smoothly finished; aperture an arch at the base of the last-formed chamber in typical development, but when uniserial chambers appear the aperture becomes terminal and rounded. Length of hypotype in figure 22, 1.18 mm., breadth of triserial portion 0.43 mm., breadth of biserial portion 0.41 mm., thickness of biserial portion 0.17 mm., breadth of uniserial chambers 0.20

mm.; length of hypotype in figure 23, 1.42 mm., breadth of triserial portion 0.41 mm., breadth of biserial portion 0.43 mm., thickness of biserial portion 0.175 mm.; length of topotype in figure 24, 1.38 mm., breadth 0.40 mm.; length of hypotype in figure 25, 1.02 mm., breadth 0.29 mm.; length of hypotype in figure 26, 1.13 mm.; breadth of triserial portion 0.36 mm., breadth of uniserial portion 0.18 mm.; length of topotype in figure 27, 0.86 mm., breadth 0.36 mm.

Types.—Hypotypes of figures 22 and 25 from sample 115, hypotypes of figures 23 and 26 from sample 114, all from locality HTL-13; topotypes of figures 24 and 27 from locality HTL-42, sample 240.

Remarks.—This species is known only from the Duck Creek formation and is quite common in the samples where it occurs.

According to Cushman, the aperture in typical specimens tends to become somewhat terminal, suggesting a tendency toward *Gaudryinella*. However, he stated that no definite uniserial stage was found in his material. Although uniserial forms have now been found, they are not common, and the species is left with the genus *Gaudryina*, as that seems to be the typical development,

EXPLANATION OF PLATE 79

Families Ophthalmitidae to Lagenidae

- FIGS. 1, 2—*Nubecularia depressa* Chapman. Side views, $\times 53$. (p. 491)
 3–5—*Trochammina krumensis* Tappan, n. sp. 3, Holotype, 4, 5, paratypes. 3a, 5b, Dorsal views, (p. 492)
 3b, 4, 5a, ventral views, 3c, 5c, edge views, $\times 76$. (p. 492)
 6—*Trochammina obliqua* Tappan, n. sp. 6a, Dorsal view of holotype, 6b, ventral view, $\times 53$. (p. 492)
 7—*Trochammina truncata* Tappan, n. sp. 7a, Ventral view of holotype, 7b, dorsal view, 7c, edge view, $\times 53$. (p. 492)
 8, 9—*Placopsilina longa* Tappan. 8, Lateral view, $\times 17$. 9a, Attached surface, 9b, external side view, 9c, top view, $\times 10$. (p. 493)
 10—*Placopsilina minima* Tappan, n. sp. 10a, Side view of holotype, showing attachment, $\times 20$. (p. 493)
 10b, Side view, enlarged, $\times 53$. (p. 493)
 11—*Placopsilina expansa* Tappan, n. sp. Side view of holotype, $\times 35$. (p. 493)
 12—*Darbyella subcretacea* Tappan, n. sp. 12a, Dorsal view of holotype, 12b, edge view, $\times 35$. (p. 493)
 13–15—*Lenticulina gaultina* (Berthelin). 13, Side view, $\times 20$. 14a, Side view, 14b, face view, $\times 53$. 15a, Side view, 15b, face view, $\times 17$. (p. 494)
 16, 17—*Marginulina paucicosta* Tappan, n. sp. 16, Holotype, 17, paratype, 16a, 17a, side views, (p. 494)
 16b, 17b, edge views, $\times 53$. (p. 494)
 18—*Marginulina planitesta* Tappan, n. sp. 18a, Side view of holotype, 18b, edge view, $\times 76$. (p. 495)
 19, 20—*Marginulina lenticulinoidea* Tappan, n. sp. 19, Holotype, 20, paratype, 19a, 20a, side views, 19b, 20b, face views, $\times 35$. (p. 494)
 21–25—*Marginulina tenuissima* Reuss. 21–25a, Side views, 25b, face view, $\times 35$. (p. 495)
 26—*Marginulina striatifera* Tappan, n. sp. 26a, Side view of holotype, 26b, edge view, $\times 35$. (p. 495)
 27—*Dentalina* sp. Side view, $\times 46$. (p. 496)
 28, 29—*Dentalina communis* (d'Orbigny). Side views, $\times 35$. (p. 495)
 30, 31—*Dentalina cylindroides* Reuss. 30, side view, $\times 17$, 31, abnormal specimen, $\times 53$. (p. 495)

while the few *Gaudryinella*-like specimens show a tendency, but are not considered diagnostic.

GAUDRYINA SUBCRETACEA Cushman
Plate 78, figures 28, 29

Gaudryina subcretacea CUSHMAN, 1936, Cushman Lab. Foram. Research Spec. Pub. 6, p. 5, pl. 1, figs. 11a, b; 1937, idem, Spec. Pub. 7, p. 35, pl. 4, figs. 12a, b.

Test, medium-sized, triserial and flattened-triangular at the base, later biserial, periphery subacute; chambers increasing gradually in size, generally slightly collapsed centrally; sutures fairly distinct, thickened and raised; wall rather coarsely arenaceous, may be smoothly finished or somewhat rough; aperture at the base of the last-formed chamber, extending upward into the apertural face. Length of topotype in figure 28, 0.84 mm., breadth 0.34 mm., thickness 0.23 mm.; length of topotype in figure 29, 0.70 mm., breadth 0.30 mm.

Types.—Topotypes from locality HTL-34, sample 212.

Remarks.—This species is known only from the Duck Creek formation, and occurs rarely. It is distinguished from *G. alexanderi* Cushman by its smaller size and flattened triserial portion. One of the sides of *G. subcretacea* has much less breadth than the others, so that the third angle, which is eventually lost, is somewhat to one side of the center of the test.

Genus GAUDRYINELLA Plummer, 1931
GAUDRYINELLA DELRIOENSIS Plummer
Plate 78, figure 30

Gaudryinella delrioensis PLUMMER, 1931, Am. Midland Naturalist, vol. 12, p. 341, text figs. 1a, b; 1931, Texas Univ. Bull. 3101, p. 137, pl. 9, fig. 13.

Gaudryinella delrioensis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 99, pl. 15, fig. 7. Includes additional synonymy.

Test small, elongate, early chambers triserially arranged, later closely biserial, grading into loosely arranged biserial chambers and then becoming rectilinear and finally uniserial; chambers increase rapidly in size, low at first and then rapidly becoming higher, inflated centrally; sutures distinct and much depressed; wall coarsely arenaceous, roughly finished; aperture at the base of the last-formed chamber during triserial

and biserial development, then becoming terminal in the uniserial chambers. Length of hypotype 0.35 mm., breadth 0.17 mm.

Types.—Hypotype from locality HTL-13, sample 118.

Remarks.—*Gaudryinella delrioensis* Plummer ranges throughout the Washita group but is rare in the lower part, being best developed in the Del Rio clay of southern Texas. The Duck Creek specimens are generally small, none with a truly uniserial development having been observed.

GAUDRYINELLA IRREGULARIS
Tappan, n. sp.
Plate 78, figures 31–32

Test tiny, elongate, very early portion triserial, forming a somewhat globular base, then rapidly becoming loosely triserial and finally uniserial; chambers inflated, globular, later ones becoming somewhat elongate, increasing rapidly in size from the initial portion, then increasing more slowly; sutures distinct, deeply depressed; wall medium to finely arenaceous, smoothly finished; aperture terminal, rounded, at the end of a distinct neck. Length of holotype 0.34 mm., breadth of last chamber 0.08 mm., length of paratype 0.27 mm., breadth of last chamber 0.08 mm.

Types.—Holotype and paratype from locality HTL-27, sample 169.

Remarks.—This species occurs more abundantly in the Duck Creek formation than does *G. delrioensis* Plummer, from which it differs in its smaller size and more delicate test, much less well developed triserial and biserial stages, more elongate and loosely arranged uniserial chambers, smoothly finished wall and the elongate neck. *G. irregularis* shows a tendency toward the characters of *Pseudoclavulina*, as the biserial stage is poorly developed and the aperture occurs at the end of a distinct neck. This bears out the suggested derivation of the latter genus from *Gaudryinella*.

Family MILIOLIDAE
Genus QUINQUELOCULINA d'Orbigny,
1826

QUINQUELOCULINA MINIMA Tappan, n. sp.
Plate 78, figures 33a, b

Test very tiny, ovate, periphery bluntly

rounded; chambers added in typical quinqueloculine fashion, last chambers overlapping a large proportion of the earlier ones on the side where four chambers are visible, where only three are visible the central chamber occupies over one-third of the breadth, chambers quite thick; sutures distinct, depressed; wall calcareous, imperforate; aperture simple, at the end of the chamber, no tooth visible. Length of holotype 0.182 mm., breadth 0.12 mm., thickness 0.10 mm.

Type.—Holotype from locality HTL-57, sample 296.

Remarks.—This species differs from *Quinqueloculina seminula* (Linné) in its much smaller size, bluntly rounded periphery, and in lacking the apertural tooth.

Family OPTHALMIDIIDAE

Subfamily OPTHALMIDIINAE

Genus OPTHALMIDIUM Zwingli and

Kübler, 1870

OPHTHALMIDIUM ADHAERENS

Tappan, n. sp.

Plate 78, figures 34a–35

Test small, flattened, apparently attached, planispiral, with globular proloculum followed by chambers of one-half coil in length, later chambers decreasing in length so that there are three to a coil in the adult; chambers increasing rapidly in size and last chambers much inflated, with a triangular cross section; sutures indistinct, but centers of chambers usually of clear or darker calcite so that the chambers can be distinguished; wall calcareous, imperforate, mostly of a chalky white color; aperture at the end of the chamber and may be on a slight neck. Greatest diameter of holotype 0.41 mm., breadth 0.37 mm., thickness 0.15 mm.; greatest diameter of paratype 0.17 mm., breadth 0.20 mm., thickness 0.06 mm.

Types.—Holotype from sample 116, paratype from sample 119, both from locality HTL-13.

Remarks.—Both specimens figured seem to show a reverse in the direction of coiling in the development of the test, a feature noticed in other species of this genus by Macfadyen (1939), who stated,

In one figure of *O. ovale* Burbach and in two of my specimens of *O. acutimargo* the direction of coiling

is reversed at one point in the development from a clockwise to a counter-clockwise direction.

O. adhaerens differs from *O. inconstans* Brady in the much smaller size and in possessing definitely three-chambered whorls, which are in contact, without an intervening plate. The specimens are very much flattened on one side and seem to have been attached, although this is not characteristic of the genus.

OPHTHALMIDIUM MINIMA

Tappan, n. sp.

Plate 78, figures 36–37b

Test small, flattened, periphery bluntly rounded; ovate proloculum followed first by a tubular chamber and then by two chambers to a coil; chambers clear in the center so that their arrangement can be seen, but sutures themselves are indistinct; wall calcareous, imperforate; aperture simple, at the end of the chamber. Length of holotype 0.46 mm., breadth 0.23 mm., thickness 0.05 mm.; length of paratype 0.44 mm., breadth 0.26 mm., thickness 0.05 mm.

Types.—Holotype from locality HTL-13, sample 114; paratype from locality HTL-35, sample 277.

Remarks.—This species differs from *O. acutimargo* (Brady) in the much smaller size and more numerous and narrower chambers, blunt periphery and comparatively less flattening. This species is of the type designated *Spirophthalmidium* by Cushman, but according to Macfadyen the genotypes of *Ophthalmidium* and *Spirophthalmidium* are congeneric. Hence, the present species is described under *Ophthalmidium*.

Subfamily NUBECULARIINAE

Genus NUBECULARIA Defrance, 1825

NUBECULARIA DEPRESSA Chapman

Plate 79, figures 1, 2

Nubecularia depressa CHAPMAN, 1891, Royal Micr. Soc. Jour., p. 572, pl. 1 (9), fig. 1.

Test tiny, slender, attached; globular proloculum followed by a single coil consisting of two chambers, early chambers not in contact but joined by a thin plate, then chambers become uniserially arranged in a straight or arcuate series, chambers pyriform in outline, blunt and rounded proximally, tapering toward the aperture; su-

tures indistinct in the early portion, distinct in the uniserial part; wall calcareous, imperforate; aperture simple, terminal. Length of hypotype in figure 1, 0.59 mm., length of a single uniserial chamber 0.19 mm., breadth of coil 0.10 mm.; length of hypotype of figure 2, 0.69 mm., greatest breadth of coil 0.13 mm., least breadth of coil 0.126 mm., greatest breadth of uniserial chamber 0.056 mm.

Types.—Hypotypes from locality HTL-13, sample 120.

Remarks.—This species was originally described from the Gault of England, and the geographic range is here extended to the Duck Creek formation of Texas and Oklahoma.

Family TROCHAMMINIDAE
Genus TROCHAMMINA Parker and
Jones, 1859

TROCHAMMINA KRUMENSIS
Tappan, n. sp.

Plate 79, figures 3a–5c

Test small, attached dorsally; ventrally slightly umbilicate, dorsal side flattened, ventral side convex, periphery rounded, lobulate; chambers numerous, 9 to 12 visible on the ventral side, the variation perhaps due to the difference in microspheric and megalospheric generations, about two or three whorls visible dorsally, chambers increasing very gradually in size, last chamber generally quite inflated, and in a few specimens extends somewhat ventrally over the umbilicus, wall of some chambers absent on the dorsal side by which the test was attached, so that the chambers open onto the attachment; sutures distinctly depressed ventrally, observable also on the dorsal side; wall thick, finely arenaceous, generally reddish in color; aperture at the inner margin of the ventral side of the chamber. Greatest diameter of holotype 0.38 mm., least diameter 0.29 mm., greatest thickness 0.15 mm.; greatest diameter of paratype in figure 4, 0.36 mm., least diameter 0.23 mm., thickness 0.13 mm.; greatest diameter of paratype in figure 5, 0.29 mm., least diameter 0.21 mm., thickness 0.10 mm.

Types.—Holotype from locality HTL-38, sample 224; paratype of figure 4 from locality HTL-57, sample 295; paratype of figure 5 from locality HTL-27, sample 165.

Remarks.—This species is probably the most common species of *Trochammina* in the Duck Creek formation. It is distinguished from *T. inflata* (Montagu) in the more inflated last chamber, greater number of chambers, sharper periphery and ventral attachment. It is distinguished from *T. obliqua* Tappan by the inflated chambers, less oblique sutures, ventral attachment and lobulate periphery. *

TROCHAMMINA OBLIQUA

Tappan, n. sp.

Plate 79, figures 6a, b

Test free, tiny, trochoid, flattened, ventrally umbilicate, convex dorsally, periphery subacute; chambers numerous, five in the last whorl, increasing rapidly in size; sutures distinct, depressed, oblique on the dorsal side but only slightly curved ventrally; wall finely arenaceous, with considerable cement; aperture an arch at the base of the apertural face of the last-formed chamber. Greatest diameter of holotype 0.37 mm., least diameter 0.28 mm., thickness 0.08 mm.

Type.—Holotype from locality HTL-13, sample 120.

Remarks.—This species differs from *Trochammina diagonis* Carsey in the less lobulate periphery, more oblique sutures dorsally, and smaller size.

TROCHAMMINA TRUNCATA

Tappan, n. sp.

Plate 79, figures 7a–c

Test small, trochoid, attached ventrally, ventral side flattened, dorsal side flattened and concave centrally, periphery broadly truncate; chambers numerous, seven in the last volution, about $2\frac{1}{2}$ whorls visible dorsally, chambers increasing gradually in height, increasing rapidly in thickness, collapsed dorsally; sutures straight, thickened, distinct; wall thick, finely arenaceous, with considerable cement; aperture apparently at the base of the apertural face of the last chamber, slightly toward the dorsal side. Greatest diameter of holotype 0.43 mm., least diameter 0.40 mm., thickness 0.15 mm.

Type.—Holotype from locality HTL-35, sample 278.

Remarks.—This species differs from *T. krumensis* in the flattened dorsal side and

bluntly truncate periphery, and the straight, nondepressed sutures.

Family PLACOPSILINIDAE

Genus PLACOPSILINA d'Orbigny, 1850

PLACOPSILINA LONGA Tappan

Plate 79, figures 8-9c

Placopsilina longa TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 100, pl. 15, figs. 9a-10.

Test large, early portion coiled, attached, later uniserial and usually growing free of the attachment, periphery sharp in the attached portion, later free uniserial chambers rounded in section; usually five chambers present in the coil, with a very large umbilical plug protruding above the remainder of the chambers, but occasionally broken out, uniserial chambers short, increasing very slowly in diameter, frequently the uniserial portion is broken from the attached portion of the test and occurs as a straight series of chambers; sutures distinct, straight, depressed; wall thick, coarsely arenaceous; aperture terminal on the rounded uniserial chambers. Length of hypotype in figure 8, 1.61 mm., thickness 0.30 mm.; length of hypotype in figure 9, 2.26 mm., breadth of coiled portion 0.73 mm., thickness through coil 0.37 mm., breadth of uniserial portion 0.52 mm.

Types.—Hypotype of figure 8 from locality HTL-13, sample 113; hypotype of figure 9 from locality HTL-60, sample 303.

Remarks.—This species was originally described from the Grayson formation, has been recorded in a faunal list from the Denton formation, and the range is here extended downward to include the Duck Creek formation. The species is fairly common in this formation, and the free uniserial portions are found broken loose in some abundance.

PLACOPSILINA MINIMA Tappan, n. sp.

Plate 79, figures 10a, b

Test small, attached, early portion coiled, later uniserial; chambers increasing fairly rapidly in size, height about equal to breadth, about four chambers in the coiled portion, with a large umbilical plug protruding above the remainder of the coil; sutures distinct, depressed; wall coarsely arenaceous; aperture an arch on the terminal end,

next to the attachment. Length of holotype 0.66 mm., breadth of coil 0.13 mm.; breadth of last chamber of uniserial portion 0.15 mm.

Type.—Holotype from locality HTL-13, sample 121.

Remarks.—This species is fairly common in the Duck Creek formation, but no specimens growing free from the attachment have been observed. It is distinguished from *P. longa* Tappan by its much smaller size and higher chambers, which increase more rapidly in size.

PLACOPSILINA EXPANSA

Tappan, n. sp.

Plate 79, figure 11

Test medium-sized, attached, compressed, with a small coil at the initial end, then chambers become uniserially arranged and rectilinear; chambers low and broad, increasing gradually in size; sutures indistinct in coiled portion, later distinct and depressed, arched centrally; wall finely arenaceous, with considerable cement; aperture terminal, arching upward from the attached side. Length of holotype 0.65 mm., breadth 0.42 mm., thickness 0.08 mm.

Type.—Holotype from locality HTL-27, sample 165.

Remarks.—This species differs from *P. longa* Tappan in its smaller size, in the small coiled portion lacking an umbilical plug, and in the very broad and low but arched chambers.

Family LAGENIDAE

Subfamily NODOSARIINAE

Genus DARBYELLA Howe and Wallace, 1933

DARBYELLA SUBCRETACEA Tappan, n.sp.

Plate 79, figures 12a, b

Test medium-sized, early stage planispiral, later chambers to one side of the previous plane of coiling so that 15 chambers may be seen on one side but only 10 on the other, periphery subacute; chambers numerous, low; sutures distinct, slightly raised in the early portion, later depressed; wall calcareous, surface ornamented by seven or eight fine ribs, roughly paralleling the periphery of the later portion of the test, but which may bifurcate or fuse with

other ribs after short distances, ribs most numerous in about the middle portion of the test, thinning out toward the aperture; aperture rounded, slightly below the peripheral angle in the apertural face. Greatest diameter of holotype 0.59 mm., greatest breadth of coiled portion 0.36 mm., thickness 0.17 mm.

Type.—Holotype from locality HTL-34, sample 210.

Remarks.—This species differs from *Robulus costatus* (Fichtel and Moll) in the more elongate and flatter test, more numerous ribs, and in the later chambers being to one side of the previous plane of coiling.

Genus LENTICULINA Lamarck, 1804

LENTICULINA GAULTINA (Berthelin)

Plate 79, figures 13–15b

Cristellaria gaultina BERTHELIN, 1880, Geol. Soc. France Mém., sér. 3, t. 1, no. 5, p. 49, pl. 3 (26), figs. 15–19.

Lenticulina gaultina, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 101, pl. 15, figs. 11a, b. Includes additional synonymy.

Test medium-sized, planispiral, sharply keeled; chambers numerous, increasing gradually in size, 12 in the last whorl of the large hypotype, young tests frequently show a proportionately wider face than older specimens, raised umbo present; sutures smooth or slightly elevated near the umbo, very gently curved or nearly straight; wall calcareous, smooth; aperture radiate at the peripheral angle. Greatest diameter of hypotype in figure 13, 1.03 mm., least diameter 0.64 mm., thickness through center 0.32 mm.; greatest diameter of hypotype in figure 14, 0.41 mm., least diameter 0.22 mm., width of apertural face 0.17 mm.; length of specimen in figure 15, 1.13 mm., breadth 0.49 mm., thickness 0.18 mm.

Types.—Hypotypes of figures 13 and 14 from locality HTL-13, sample 112; hypotype of figure 15 from locality HTL-13, sample 121.

Remarks.—This species ranges throughout the Washita group, and is abundant in the Duck Creek. It has also been recorded from France, England, Germany and Western Australia. There is considerable variation in the size and outline of the specimens as well as in the development of the keel. Two of the variations are illustrated,

and a few twinned specimens have also been observed.

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA LENTICULINOIDEA

Tappan, n. sp.

Plate 79, figures 19a–20b

Test small, early portion planispiral, later chambers tending to uncoil, sometimes umbonate, periphery usually with a sharp keel; chambers numerous, usually eight or nine in the coiled portion, generally with two uncoiled chambers, which are flattened; sutures distinct, may be raised, slightly curved; wall calcareous, smooth, except for the occasionally slightly raised sutures; aperture radiate, at the peripheral angle. Length of holotype 0.59 mm., breadth of coil 0.41 mm., thickness through center 0.20 mm.; length of paratype 0.66 mm., breadth of coil 0.36 mm., thickness 0.18 mm.

Types.—Holotype from sample 119, paratype from sample 112, both from locality HTL-13.

Remarks.—The early portion resembles *Lenticulina gaultina* (Berthelin) in some respects, but the species differs in possessing fewer chambers per revolution, and the specimens never attain the large size of an adult *L. gaultina*. *Marginulina lenticulinoidea* differs further in possessing the uncoiled portion of the test.

MARGINULINA PAUCICOSTA Tappan,

n. sp.

Plate 79, figures 16a–17b

Test small, elongate, narrow, arcuate; chambers numerous, increasing rapidly in size, height greater than breadth; sutures distinct, depressed, oblique; wall calcareous, surface ornamented by 8 to 10 very low and narrow and widely spaced longitudinal ribs; aperture radiate, terminal, at the end of a slight neck. Length of holotype 0.63 mm., breadth of last chamber 0.11 mm.; length of paratype 0.44 mm., breadth 0.11 mm.

Types.—Holotype and paratype from locality HTL-34, sample 214.

Remarks.—This species differs from *M. tenuissima* (Reuss) in the more tapering initial portion, slender arcuate test, rather than definitely coiled at the base, and in the lower ribs and more oblique sutures.

MARGINULINA PLANITESTA Tappan,
n. sp.

Plate 79, figures 18a, b

Test tiny, arcuate or slightly coiled at the base; chambers broad, inflated; sutures distinct, depressed, slightly oblique; wall calcareous, smooth; aperture rounded, terminal. Length of holotype 0.40 mm., breadth 0.08 mm.

Type.—Holotype from locality HTL-13, sample 117.

Remarks.—This species differs from *M. tenuissima* Reuss in the smooth surface and less distinct initial coiling and in lacking the slight neck at the apertural end.

MARGINULINA STRIATIFERA Tappan,
n. sp.

Plate 79, figures 26a, b

Test medium-sized, elongate, the coil at the base forming a bluntly rounded initial end; later chambers low, circular in cross section; sutures straight, obscure in early portion, later sutures depressed; wall calcareous, surface ornamented by 24 to 30 very fine and low ribs, which twist slightly about the test; aperture rounded, at the end of a slight neck. Length of holotype 0.65 mm., breadth 0.20 mm.

Type.—Holotype from locality HTL-13, sample 122.

Remarks.—This species is very similar to *M. tenuissima* Reuss, differing only in possessing much more numerous and less elevated longitudinal ribs.

MARGINULINA TENUISSIMA Reuss
Plate 79, figures 21–25b

Marginulina tenuissima REUSS, 1863, Akad. Wiss. Wien. Sitzungsber., Band 46, p. 70, pl. 7, fig. 13.

Marginulina tenuissima, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 101, pl. 17, figs. 9, 10. Includes additional synonymy.

Test small, elongate, slightly coiled at the base, then with an elongate uniserial portion; chambers numerous, length approximately equal to breadth, nearly circular in section, inflated centrally; sutures distinct, depressed, straight and varying from slightly oblique to nearly horizontal; wall calcareous, surface ornamented by about 9 to 12 longitudinal ribs, which twist slightly about the test; aperture radiate, at

the end of a slight neck at the dorsal angle. Length of hypotype in figure 21, 1.29 mm., breadth 0.17 mm.; length of hypotype of figure 22, 0.74 mm., breadth 0.19 mm.; length of hypotype of figure 23, 0.62 mm., breadth 0.20 mm.; length of hypotype of figure 24, 0.65 mm., breadth 0.22 mm.; length of hypotype of figure 25, 0.83 mm., breadth 0.25 mm., thickness 0.22 mm.

Types.—Hypotypes of figures 21, 22 and 24 from locality HTL-27, sample 166; hypotype of figure 23 from locality HTL-57, sample 295; hypotype of figure 25 from locality HTL-13, sample 112.

Remarks.—This species was originally described from Germany, and has been also recorded from England and from the entire Washita group of Texas and Oklahoma. The species is quite variable in size and proportions, some specimens having a large blunt coiled end, and others tapering initially; the amount of inflation of the chambers and the length of the test also vary considerably.

GENUS DENTALINA d'Orbigny, 1826
DENTALINA COMMUNIS (d'Orbigny)
Plate 79, figures 28, 29

Nodosaria (Dentalina) communis D'ORBIGNY, 1826, Ann. Mag. Nat. Sci., vol. 7, p. 254, no. 35. *Dentalina communis*, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 102, pl. 16, fig. 1. Includes additional synonymy.

Test medium-sized, arcuate, elongate and slender; chambers increasing gradually in size, rounded in section, somewhat elongate; sutures distinct, depressed, oblique; wall calcareous, surface smooth; aperture radiate, terminal. Length of hypotype in figure 28, 0.62 mm., breadth 0.13 mm.; length of hypotype in figure 29, 0.89 mm., breadth 0.14 mm.

Types.—Hypotypes both from locality HTL-13, sample 113.

Remarks.—This is a very simple and generalized species and has a very wide geographic and long geologic range. It has been recorded throughout the Cretaceous of Texas.

DENTALINA CYLINDROIDES Reuss
Plate 79, figures 30–31

Dentalina cylindroides REUSS, 1860, Akad. Wiss. Wien Sitzungsber., Band 40, p. 185, pl. 1, fig. 8.

Dentalina cylindroides, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 102, pl. 16, fig. 2. Includes additional synonymy.

Test large, arcuate, very elongate, fairly thick; chambers numerous, rounded in section, length greater than diameter, initial chamber blunt, last chamber somewhat elongate; sutures distinct but not depressed, straight and horizontal; wall calcareous, surface smooth; aperture terminal, radiate. Length of hypotype of figure 30, 2.39 mm., breadth 0.22 mm.; length of hypotype of figure 31, 0.62 mm., breadth 0.12 mm.

Types.—Hypotype of figure 30 from sample 116, hypotype of figure 31 from sample 117, both from locality HTL-13.

Remarks.—This large species is characterized by the broad cylindrical chambers and unconstricted sutures. It is common throughout the Washita group, having previously been recorded from the Grayson formation of Texas and the range here being extended downward to include the Duck Creek.

DENTALINA sp.
Plate 79, figure 27

Nodosaria filiformis d'Orbigny. CARSEY, 1926, Texas Univ. Bull. 2612, p. 33, pl. 7, fig. 8.

Dentalina sp. TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 102, pl. 16, figs. 4a, b.

Test small, usually consisting of only two globular to ovate chambers; intervening suture distinct, much constricted; wall calcareous, surface smooth; aperture terminal, rounded. Length of hypotype 0.29 mm., breadth 0.12 mm.

Type.—Hypotype from locality HTL-13, sample 120.

Remarks.—This species occurs throughout the Washita and is probably represented only by fragments of longer specimens, breaking apart at the much constricted sutures.

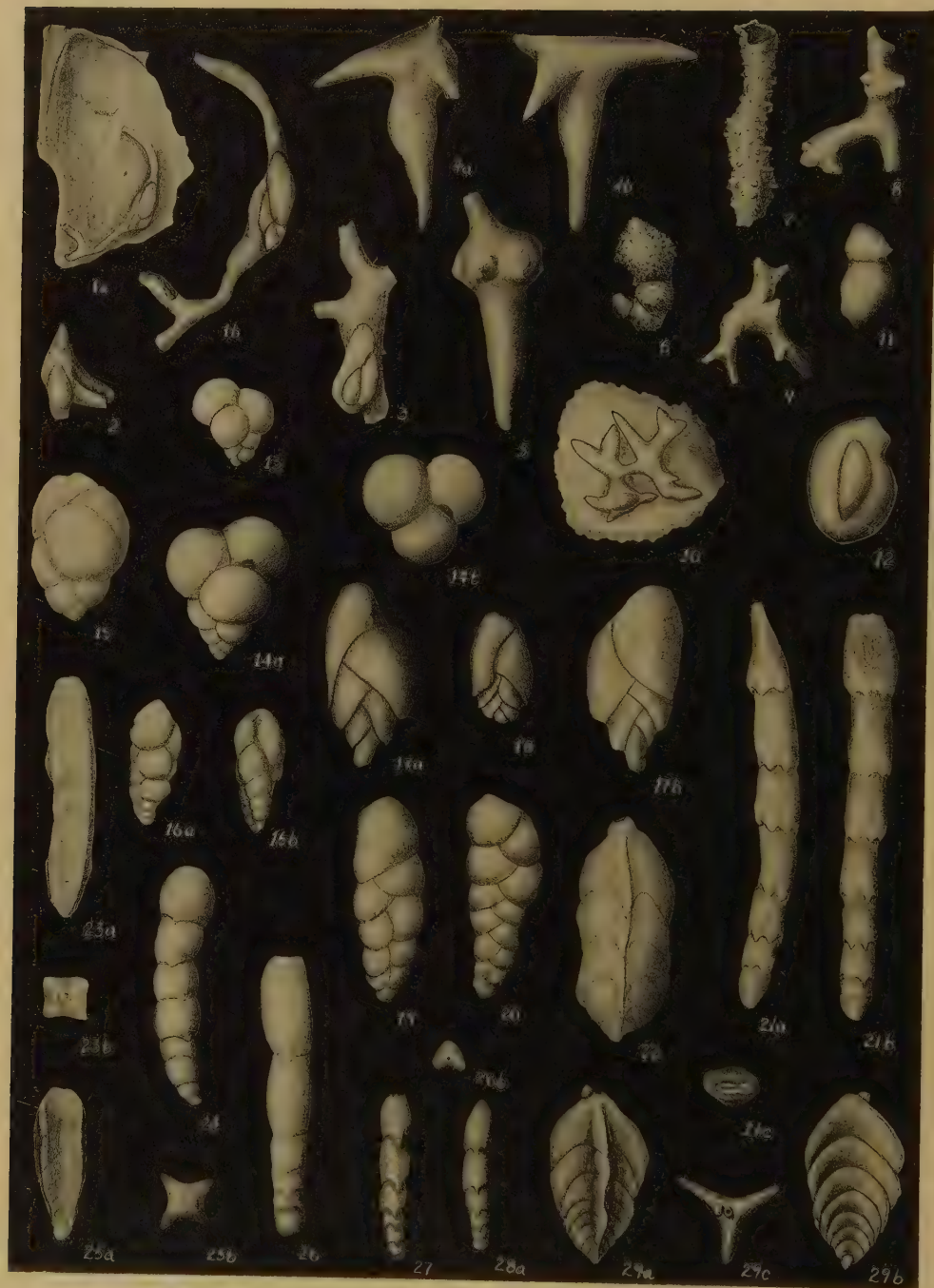
Genus NODOSARIA Lamarck, 1812
NODOSARIA OBSCURA Reuss
Plate 80, figures 1, 2

EXPLANATION OF PLATE 80 Families Lagenidae to Polymorphinidae

- FIGS. 1-2—*Nodosaria obscura* Reuss. Side views, $\times 53$. (p. 496)
3, 4—*Nodosaria oklahomensis* Tappan, n. sp. 3, Holotype, $\times 76$. 4, Paratype, $\times 35$. (p. 497)
5—*Pseudoglandulina scotti* Tappan. $\times 53$. (p. 497)
6—*Saracenaria bononiensis striatolipa* Tappan, n. var., 6a, Side view of holotype, 6b, face view, $\times 20$. (p. 498)
7, 8—*Saracenaria callitoecha* Tappan, n. sp. 7, Side view of paratype, 8, side view of holotype, $\times 76$. (p. 498)
9—*Saracenaria cushmani* Tappan. 9a, Side view, 9b, face view, $\times 46$. (p. 498)
10—*Saracenaria duckcreekensis* Tappan, n. sp. 10a, Side view of holotype, 10b, face view, $\times 46$. (p. 498)
11—*Lingulina furcillata* Berthelin. 11a, Side view, 11b, edge view, $\times 53$. (p. 499)
12, 13—*Lingulina nodosaria* Reuss. 12, $\times 20$. 13, $\times 53$. 12a, 13a, Side views, 12b, 13b, edge views. (p. 499)
14—*Vaginulina complanata perstriata* Tappan. Side view, $\times 35$. (p. 499)
15—*Vaginulina debilis* (Berthelin) Side view, $\times 35$. (p. 500)
16—*Vaginulina* cf. *debilis* (Berthelin). Side view, $\times 53$. (p. 500)
17, 18—*Vaginulina kochii* Roemer. 17a, Side view, 17b, edge view, $\times 17$. 18, side view, $\times 35$. (p. 500)
19-21—*Vaginulina kochii striolata* Reuss. 19, 21, $\times 17$. 20, $\times 35$. All side views. (p. 501)
22—*Vaginulina recta* Reuss. 22a, Side view, 22b, edge view, $\times 35$. (p. 501)
23, 24—*Vaginulina raristriata* (Chapman). Side views, $\times 20$. (p. 501)
25, 26—*Vaginulina tripleura* Reuss. 25, $\times 76$. 26, Abnormal specimen, showing flabelline tendency, $\times 46$. 25a, 26a, 26b, Side views, 25b, 26c, edge views. (p. 501)
27-29—*Vaginulina duckcreekensis* Tappan, n. sp. 27, Holotype, 28, 29, paratypes, 27b, edge view, other views from the side, $\times 17$. (p. 500)
30—*Flabellinella delicata* Loeblich and Tappan? Side view of specimen showing vaginuline stage only, $\times 46$. (p. 503)
31—*Lagena apiculata* (Reuss). $\times 53$. (p. 503)
32—*Lagena striatifera* Tappan. 32a, Side view, 32b, top view, $\times 76$. (p. 504)
33, 34—*Lagena sulcata* (Walker and Jacob). 33, 34a, Side views, 34b, top view, $\times 76$. (p. 504)
35—*Paleopolymorphina osawai* Tappan. $\times 76$. (p. 504)
36, 37—*Globulina exserta* (Berthelin). $\times 53$. (p. 504)



Tappan, Lower Cretaceous (Duck Creek) Foraminifera



Tappan, Lower Cretaceous (Duck Creek) Foraminifera

Nodosaria obscura REUSS, 1845-1846, Verstein. böhm. Kreidef., pt. 1, p. 26, pl. 13, figs. 7-9.

Nodosaria obscura, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 104, pl. 16, figs. 7a-8b. Includes additional synonymy.

Nodosaria harrisi VIEAUX, 1941, Jour. Paleontology, vol. 15, no. 6, p. 625, pl. 85, fig. 4.

Nodosaria barkeri VIEAUX, 1941, Jour. Paleontology, vol. 15, no. 6, p. 626, pl. 85, fig. 5.

Test free, medium-sized, chambers in a uniserial and rectilinear series, inflated centrally, increasing rapidly in size as added; sutures fairly distinct, somewhat constricted, horizontal, straight; wall calcareous, surface ornamented with seven to nine thin but highly elevated longitudinal ribs, extending the length of the test, initial extremity with a sharp spine, which is sometimes broken; aperture rounded, terminal on a prominent slender, tubular neck, the end of the chamber usually with a smooth and flattened area surrounding the neck. Length of hypotype in figure 1, 0.71 mm., breadth 0.19 mm.; length of hypotype in figure 2, 0.55 mm., breadth 0.10 mm.

Types.—Hypotype of figure 1 from sample 112, hypotype of figure 2 from sample 113, both from locality HTL-13.

Remarks.—This species is found throughout the Washita group and has been widely recorded elsewhere. In the Washita group, the species is more abundant in the upper formations.

NODOSARIA OKLAHOMENSIS Tappan,
n. sp.

Plate 80, figures 3, 4

Test small, uniserial, rectilinear; chambers elongate, of approximately same diameter throughout the length of the test; sutures distinct, constricted; wall calcareous, surface ornamented by 8 to 10 low longitudinal ribs; aperture terminal, simple. Length of holotype 0.38 mm., breadth 0.66 mm.; length of paratype 0.88 mm., breadth 0.11 mm.

Types.—Holotype of figure 3 from sample 120, paratype of figure 4 from sample 116, both from locality HTL-13.

Remarks.—This species differs from *N. obscura* Reuss in the lower ribs, more constricted sutures, narrower test and equal-sized chambers throughout.

Genus PSEUDOGLANDULINA Cushman,
1929

PSEUDOGLANDULINA SCOTTI Tappan
Plate 80, figures 5a-b

Pseudoglandulina scotti TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 105, pl. 16, figs. 13a, b.

Test medium-sized, elongate, tapering at the initial end; chambers wider than long, increasing rapidly in size at first, then more slowly, so that the adult test has nearly

EXPLANATION OF PLATE 81

Families Polymorphinidae to Buliminidae

- FIGS. 1-3—*Globulina redriverensis* Tappan, n. sp. 1a, Holotype, showing attachment, $\times 10$. 1b, Enlarged, $\times 20$. 2, 3, Paratypes, $\times 20$. (p. 505)
 4, 5—*Pseudopolymorphina roanokensis* Tappan. $\times 76$. (p. 506)
 6, 7—*Ramulina aculeata* Wright. 6, Specimen with globular chambers. 7, Stoloniferous type, $\times 20$. (p. 506)
 8, 9—*Ramulina globulifera* Brady. $\times 35$. (p. 506)
 10—*Bullopore cervicornis* (Chapman). Specimen showing attachment, $\times 10$. (p. 506)
 11, 12—*Bullopore laevis* (Sollas). 11, $\times 41$. 12, $\times 17$. (p. 507)
 13, 14—*Gumbelitra harrisi* Tappan. 13, 14a, Side views, 14b, top view, $\times 117$. (p. 507)
 15—*Bulimina nannina* Tappan. Side view, $\times 117$. (p. 507)
 16—*Neobulimina minima* Tappan. $\times 117$. (p. 507)
 17, 18—*Virgulina croneisi* Tappan, n. sp. 17, Holotype, 18, paratype, $\times 117$. (p. 508)
 19, 20—*Virgulina minuta* Cushman. $\times 117$. (p. 508)
 21—*Unicosiphonia subcretacea* Tappan, n. sp. 21a, b, Side views of holotype, 21c, top view, $\times 46$. (p. 508)
 22—*Dentalinopsis excavata* (Reuss). $\times 46$. (p. 509)
 23—*Dentalinopsis märtensi* (Reuss). 23a, Side view, 23b, top view, $\times 76$. (p. 509)
 24—*Dentalinopsis nodosaria* Tappan, n. sp. Holotype, $\times 53$. (p. 509)
 25—*Dentalinopsis quadrata* Vieaux. 25a, Side view, 25b, top view, $\times 27$. (p. 509)
 26-28—*Dentalinopsis chapparsi* Tappan, n. sp. 26, 27, Side views of paratypes, 28a, side view of holotype, 28b, top view. 26, $\times 76$. 27, 28, $\times 46$. (p. 509)
 29—*Dentalinopsis tricarinatum acutangulum* Reuss. 29a, 29b, Side views, 29c, top view, $\times 46$. (p. 510)

parallel sides; sutures distinct, slightly depressed; wall calcareous, surface smooth; aperture terminal, radiate. Length of hypotype 0.52 mm., breadth 0.16 mm.

Type.—Hypotype from locality HTL-13, sample 116.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation.

Genus SARACENARIA Defrance, 1824

SARACENARIA BONONIENSIS STRIATOLIPA

Tappan, n. var.

Plate 80, figures 6a, b

Test medium-sized, elongate, early portion close-coiled, later portion arcuate, tending to become rectilinear; chambers increasing rapidly in height, triangular in cross section; sutures slightly curved, convex upward, oblique, distinct, very slightly depressed; wall calcareous, smooth, a faint keel along the three angles of the test; aperture radiate, at the peripheral angle. Length of holotype 1.18 mm., breadth of side 0.26 mm., breadth of ventral face 0.25 mm.

Type.—Holotype from locality HTL-13, sample 117.

Remarks.—This variety differs from *S. bononiensis* (Berthelin) in the somewhat larger size and in lacking a rib down the center of the ventral face. The true *S. bononiensis* has also been recorded from the Washita group.

SARACENARIA CALLITOECHA Tappan,

n. sp.

Plate 80, figures 7, 8

Test small, elongate, early portion close-coiled, later portion arcuate, tending to become rectilinear; chambers increasing gradually in height, triangular in section, sutures gently curved, convex upward, oblique, very slightly depressed; wall calcareous, surface ornamented by longitudinal keels down the three angles of the test, by two longitudinal ribs down the ventral face, which die out part of the way up the last chamber, and by two ribs on each side, roughly paralleling the ventral margins, and closer to the ventral face; aperture radiate, at the end of a slight neck. Length

of holotype 0.46 mm., breadth of side 0.13 mm., breadth of ventral face 0.125 mm.; length of paratype 0.47 mm., breadth of side 0.12 mm.

Types.—Holotype and paratype from locality HTL-13, sample 120.

Remarks.—This species differs from *S. vestita* (Berthelin) in the more closely coiled initial portion, in having only two ribs on each side, and in possessing the ventral ribs. Furthermore, the ribs on the sides of *S. callitoecha* begin at the coil, and continue for nearly the entire length of the test, while in *S. vestita* (Berthelin) only a few of the ribs begin at the coil, and, after crossing the test transversely, one rib dies out at the apertural end of each chamber, new ones being inserted more ventrally to take their place.

SARACENARIA CUSHMANI Tappan

Plate 80, figures 9a, b

Saracenaria cushmani TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 106, pl. 16, figs. 17a, b.

Test medium-sized to small, close-coiled in the early portion, later tending somewhat to uncoil; chambers increasing gradually in size, triangular in section, inflated sharply just in front of the depressed sutures so that the appearance of limbate sutures is obtained, occasionally the inflation may be sufficiently sharp to give the appearance of a surficial rib, peripheral keel present, test slightly umbonate; sutures distinct, depressed, curved, convex toward the aperture; wall calcareous; aperture at the peripheral angle and raised slightly on a short neck, apertural face broad. Length of hypotype 0.51 mm., breadth of coil 0.22 mm., breadth of side 0.23 mm., breadth of ventral face 0.22 mm.

Type.—Hypotype from locality HTL-13, sample 119.

Remarks.—This species was originally described from the Grayson formation, and ranges throughout the Washita group.

SARACENARIA DUCKCREEKENSIS Tappan,

n. sp.

Plate 80, figures 10a, b

Test comparatively large, elongate, triangular in section; early portion close-coiled, later chambers uncoiled and rectilin-

ear, coiled portion small, then chambers increase rapidly in size for a short distance, slightly inflated just in front of the sutures, and regularly inflated on the ventral face, a longitudinal keel present on each of the three angles, that of the dorsal angle being very high, thin and fragile, and occasionally broken, giving the test a ragged edge; sutures distinct, slightly depressed; wall calcareous; aperture radiate, at the peripheral angle. Length of holotype 0.77 mm. breadth of side 0.25 mm., breadth of ventral face 0.27 mm.

Type.—Holotype from locality HTL-57, sample 295.

Remarks.—This species differs from *S. bononiensis* (Berthelin) in the larger size, much wider apertural face, which lacks the longitudinal rib, and in having more highly inflated chambers.

Genus LINGULINA d'Orbigny, 1826

LINGULINA FURCILLATA Berthelin

Plate 80, figures 11a, b

Lingulina furcillata BERTHELIN, 1880, Soc. geol. France Mém., sér. 3, t. 1, no. 5, p. 65, pl. 4 (27), figs. 6a-c.

Lingulina furcillata, EGGER, 1899, Bayer. Akad. Wiss. München, Abh., Cl. II, Band 21, p. 85, pl. 23, figs. 28-30.

Lingulina furcillata, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 106, pl. 16, figs. 18a-c.

Test elongate, flattened, uniserial, rectilinear; proloculum ovate, later chambers low and broad at first, increasing in height as added, arched centrally; sutures distinct, depressed, arched upward in the center of the test, V-shaped on the edges of the test; wall calcareous, surface smooth; aperture terminal, elongate. Length of hypotype 0.43 mm., breadth 0.11 mm., thickness 0.07 mm.

Types.—Hypotype from locality HTL-13, sample 118.

Remarks.—This species was described from France and has also been recorded from Germany. It has been found in the Grayson formation of Texas and the range in this area is here extended downward to include the Duck Creek.

LINGULINA NODOSARIA Reuss

Plate 80, figures 12a-13b

Lingulina nodosaria REUSS, 1863, Akad. Wiss.

Wien Sitzungsber., Band 46, p. 59, pl. 5, fig. 12.

Lingulina nodosaria, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 107, pl. 16, figs. 20a, b. Includes additional synonymy.

Test elongate, compressed, uniserial, rectilinear; proloculum globular, second chamber generally low, followed by a much higher chamber, the remainder increasing gradually in size; sutures distinct, depressed, arched gently upward over the center of the test; wall calcareous, smooth; aperture elongate, terminal, earlier apertures generally visible through the wall of the translucent test, giving an appearance characteristic of the species. Length of hypotype in figure 12, 0.92 mm., breadth 0.22 mm., thickness 0.15 mm.; length of hypotype in figure 13, 0.48 mm., breadth 0.21 mm., thickness 0.12 mm.

Types.—Hypotype of figure 12 from locality HTL-34, sample 217; hypotype of figure 13 from locality HTL-57, sample 295.

Remarks.—This species occurs throughout the Washita group of Texas and Oklahoma and is also known from England, France and Germany.

Genus VAGINULINA d'Orbigny, 1826

VAGINULINA COMPLANATA PERSTRIATA

Tappan

Plate 80, figure 14

Vaginulina complanata perstriata TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 108, pl. 16, fig. 25.

Test small, flattened, broad, coiled at the base, later chambers tending to uncoil; sutures slightly depressed, curved, convex upward, oblique; wall calcareous, surface ornamented by numerous fine ribs running obliquely from the ventral to the dorsal margin; aperture radiate, at the peripheral angle. Length of hypotype 0.76 mm., breadth 0.35 mm., thickness 0.11 mm.

Type.—Hypotype from locality HTL-34, sample 214.

Remarks.—This variety of Reuss' species was originally described from the Grayson formation and the range is here extended downward to include the Duck Creek formation.

VAGINULINA DEBILIS (Berthelin)

Plate 80, figure 15

Marginulina debilis BERTHELIN, 1880, Soc. géol. France Mém., sér. 3, t. 1, no. 5, p. 3, pl. 3 (26), fig. 28.

Vaginulina debilis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 108, pl. 16, figs. 26a, b. Includes additional synonymy.

Test medium to small, elongate, arcuate, slender, tapering, subtriangular in section; chambers inflated ventrally toward their bases, tapering toward the aperture, increasing in height as added, ventral side wide, margins angular, resulting in a triangular section; sutures distinct, depressed, oblique, highest at the concave dorsal margin; wall calcareous, surface smooth; aperture radiate, at the dorsal angle, which is produced and necklike in appearance. Length of hypotype 0.95 mm., breadth 0.99 mm.

Type.—Hypotype from locality HTL-13, sample 119.

Remarks.—This species was originally described from France and has been recorded from England and Germany, and from the Grayson and Denton formations of Texas. The range in the Gulf Coast area is here extended downward to include the Duck Creek formation.

VAGINULINA sp. cf. *V. DEBILIS* (Berthelin)

Plate 80, figure 16

Test elongate, narrow, early chambers slightly coiled, later rectilinear, chambers elongate, inflated ventrally; sutures distinct, depressed, oblique; wall calcareous, surface smooth; aperture terminal, at the dorsal angle. Length of hypotype 0.65 mm., breadth of last chamber 0.08 mm.,

Type.—Hypotype from locality HTL-13, sample 113.

Remarks.—This species may be only a microspheric form of *V. debilis* (Berthelin) as it is similar in many features. It differs in the straight rather than curved dorsal margin and in the more distinct coil at the base, and in having a globular rather than a basally pointed proloculum.

VAGINULINA DUCKCREEKENSIS Tappan,
n. sp.

Plate 80, figures 27a-29

Test large, broad, elongate, sides flat and

parallel, periphery concave; chambers low, oblique, increasing gradually in size from the elongate-oval proloculum, which has a concave surface, rather than being globular and inflated; sutures distinct, slightly raised, oblique; wall calcareous, surface smooth and slightly concave, except for the raised sutures and low keels at the angles of the test; aperture radiate, at the dorsal angle. Length of holotype 2.77 mm., breadth 0.45 mm., thickness 0.17 mm., thickness through proloculum 0.13 mm.; length of paratype of figure 28, 2.13 mm., breadth 0.45 mm.; length of paratype of figure 29, 0.67 mm., breadth 0.17 mm.

Types.—Holotype and paratypes from locality HTL-34, sample 210.

Remarks.—This species is similar in general appearance to *V. kochii* Roemer, and the two species may have been confused. The present species differs mainly in the character of the proloculum, which is quite elongate, basally pointed, and with concave sides, while that of *V. kochii* as well as *V. recta* Reuss is much inflated above the remainder of the test, and is globular in outline. The sutures of *V. duckcreekensis* are also less elevated and the sutures more oblique.

VAGINULINA KOCHII Roemer

Plate 80, figures 17a-18

Vaginulina kochii ROEMER, 1840-1841, Verstein. norddeutsch. Kreidef., p. 96, pl. 15, fig. 10.

Vaginulina kochii, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 109, pl. 17, figs. 2-4. Includes additional synonymy.

Test large, compressed, elongate-triangular in side view, sides parallel, periphery slightly concave, peripheral angles carinate; chambers increasing gradually in size from the globular proloculum, which is raised above the plane surface of the remainder of the test, chambers broad and low; sutures distinct, thickened and raised, strongly oblique, curved, convex upward; wall calcareous, surface smooth; aperture radiate at the dorsal angle of the test. Length of microspheric hypotype in figure 17, 2.95 mm., breadth 0.56 mm.; length of megalospheric hypotype of figure 18, 0.31 mm., breadth 0.18 mm., thickness through proloculum 0.20 mm., thickness through chambers 0.11 mm.

Types.—Hypotype of figure 17 from locality HTL-13, sample 121; hypotype of figure 18 from locality HTL-34, sample 218.

Remarks.—This species occurs abundantly throughout the Washita group, and has also been observed in Germany, France, and England.

VAGINULINA KOCHII STRIOLATA Reuss
Plate 80, figures 19–21

Vaginulina striolata REUSS, 1863, Akad. Wiss. Wien Sitzungsber., Band 46, pt. 1, p. 45, pl. 3, fig. 7.

Vaginulina kochii striolata, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 110, pl. 17, fig. 5. Includes additional synonymy.

This variety differs from *V. kochii* Roemer in the presence of a variable number of obliquely transverse striations cutting the raised sutures into a series of short, oblique ridges, which may continue as ribs across the chambers, the amount of ornamentation varying considerably in different specimens. Length of microspheric specimen in figure 19, 2.09 mm., breadth 0.58 mm.; length of megalospheric specimen in figure 20, 0.53 mm., breadth 0.27 mm., thickness through proloculum 0.22 mm., thickness through center of chamber 0.19 mm., thickness at edge of chamber 0.10 mm.; length of microspheric specimen in figure 21, 1.78 mm., breadth 0.52 mm., thickness 0.17 mm.

Types.—Hypotype of figure 19 from locality HTL-13, sample 116; hypotype of figure 20 from locality HTL-34, sample 218; hypotype of figure 21 from locality HTL-57, sample 296.

Remarks.—This species ranges throughout the Washita group and has also been observed in England, France, and Germany.

VAGINULINA RARISTRATA (Chapman)
Plate 80, figures 23–24

Nodosaria (Dentalina) raristriata CHAPMAN, 1893, Royal Micr. Soc. Jour., p. 591, pl. 7 (9), fig. 4.

Test large, elongate, arcuate, tapering, triangular in section; chambers increasing in size as added, inflated ventrally, elongate; sutures oblique, depressed on the ventral margin, otherwise not distinct; wall calcareous, surface ornamented by numerous fine transverse ribs crossing the chambers;

aperture terminal at the dorsal angle. Length of hypotype of figure 23, 1.55 mm., breadth 0.17 mm.; length of hypotype of figure 24, 1.81 mm., greatest breadth 0.24 mm., thickness 0.15 mm.

Types.—Hypotype of figure 23 from sample 119, hypotype of figure 24 from sample 120, both from locality HTL-13.

Remarks.—This species is somewhat similar to *Vaginulina debilis* (Berthelin) in general features, but differs in the larger size, less inflation of the chambers and in the presence of the transverse ribs on the surface. Chapman described the species as a *Nodosaria* but this specimen was definitely arcuate. His illustration does not show quite as definite a triangular section, but the specimens are probably the same species.

VAGINULINA RECTA Reuss
Plate 80, figures 22a–b

Vaginulina recta REUSS, 1863, Akad. Wiss. Wien Sitzungsber., Band 46, p. 48, pl. 3, figs. 14, 15.

Vaginulina recta, SCHMITT, 1929, Zeitsch. f. Geschiebef., Band 5, Heft 3, pl. 5, fig. 21.

Vaginulina recta, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 110, pl. 17, figs. 7a–8. Includes additional synonymy.

Test elongate, narrow, compressed, sides parallel, periphery slightly concave; chambers numerous, increasing very gradually in size from the globular proloculum, which protrudes somewhat above the surface of the remainder of the test, increase in size sufficiently gradual that the edges of the test are generally subparallel; sutures distinct, raised, oblique; wall calcareous, surface smooth, except for the raised sutures; aperture radiate, at the dorsal angle, which is produced into a slight neck. Length of hypotype 0.89 mm., breadth 0.19 mm., thickness through proloculum 0.12 mm., thickness of later chambers 0.10 mm.

Type.—Hypotype from locality HTL-13, sample 119.

Remarks.—This species occurs throughout the Washita group but is somewhat less common than is *V. kochii* Roemer.

VAGINULINA TRIPLEURA (Reuss)
Plate 80, figures 25a–26c

Cristellaria tripleura REUSS, 1860, Akad. Wiss. Wien Sitzungsber., Band 40, p. 211, pl. 9, fig. 5.

Vaginulina tripleura, TAPPAN, 1940, Jour. Paleon-

tology, vol. 14, no. 2, p. 111, pl. 17, figs. 11a-12b. Includes additional synonymy.

Test small, flattened, early portion slightly coiled, later chambers uncoiling, periphery rounded; chambers numerous; sutures distinct, depressed, quite oblique; wall calcareous, surface smooth; aperture radiate at the peripheral angle. Length of hypotype in figure 25, 0.52 mm., breadth 0.13 mm., greatest thickness 0.07 mm.; length of hypotype in figure 26, 0.48 mm., breadth 0.26 mm., thickness 0.13 mm.

Types.—Hypotype of figure 25 from locality HTL-13, sample 120; hypotype of figure 26 from locality HTL-34, sample 218.

Remarks.—This species ranges throughout the Washita group and is quite variable in size and proportions. The specimen in figure 26 shows a freakish development of the last chamber, tending toward *Palmula* in character.

Genus *PALMULA* Lea, 1833

PALMULA ACUTA Loeblich and Tappan²

Palmula acuta LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 7, pl. 1, figs. 3, 4.

Types.—Holotype from locality HTL-34, sample 210; paratypes from locality HTL-34, sample 211 and locality HTL-27, sample 169.

PALMULA HOWEI Loeblich and Tappan

Palmula howei LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 9, pl. 2, figs. 4-7.

Types.—Holotype from the Duck Creek formation at locality HTL-57, sample 296; paratypes from the middle Duck Creek at the same locality, the middle and upper Duck Creek at locality HTL-13, the upper Duck Creek at localities HTL-34, and HTL-35, and from the Fort Worth formation.

PALMULA LEAI Loeblich and Tappan

Palmula leai LOEBLICH and TAPPAN, 1941, Bull.

² The species of *Palmula*, *Frondicularia* and *Flabellinella* from the Duck Creek formation were recently illustrated and described (Loeblich and Tappan, 1941) and are merely listed, with the reference and type localities, but neither illustrated nor described herein.

Am. Paleontology, vol. 26, no. 99, p. 10, pl. 1, figs. 1-2.

Types.—Holotype from locality HTL-34, sample 210; paratypes from locality HTL-34, sample 211, and from the lower and middle Duck Creek at locality HTL-27.

PALMULA LEPTATA Loeblich and Tappan

Palmula leptata LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 11, pl. 2, fig. 2.

Types.—Holotype from locality HTL-34, sample 211; paratype from locality HTL-27, sample 165.

Genus *FRONDICULARIA* DeFrance, 1826

FRONDICULARIA HILLI Loeblich and Tappan

Frondicularia hilli LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 15, pl. 3, figs. 2, 3.

Types.—Holotype and paratype from locality HTL-34, sample 210.

FRONDICULARIA UNGERI Reuss

Frondicularia ungeri REUSS, 1863, Akad. Wiss. Wien Sitzungsber., Band 46, p. 54, pl. 4, figs. 11a, b.

Frondicularia ungeri, LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 16, pl. 3, figs. 5-7. Includes additional synonymy.

Types.—Hypotypes from the Duck Creek at locality HTL-13; hypotypes also from the Weno, Paw Paw and Grayson formations of the Washita. The type locality is in Germany, and the species has also been recorded from England, France and Western Australia.

FRONDICULARIA sp. A. Loeblich and Tappan

Frondicularia sp. A. LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 17, pl. 3, fig. 9.

Types.—Hypotypes from locality HTL-57, sample 296; and from locality HTL-13, sample 119.

FRONDICULARIA sp. B. Loeblich and Tappan

Frondicularia sp. B. LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 18, pl. 3, fig. 8.

Type.—Hypotype from locality HTL-27, sample 169.

Genus FLABELLINELLA Schubert, 1900
FLABELLINELLA DELICATA Loeblich and Tappan

Flabellinella delicata LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 18, pl. 2, figs. 17-19.

Types.—Holotype from locality HTL-34, sample 213; paratypes from sample 212 and 216 at the same locality, and from the lower and middle Duck Creek at locality HTL-13, and from the Middle Duck Creek at locality HTL-57.

FLABELLINELLA DELICATA Loeblich and Tappan?
Plate 80, figure 30

Test small, flattened, elongate, chambers increasing gradually in size from the globular and raised proloculum; sutures distinct, depressed, oblique; wall calcareous, surface smooth; aperture radiate, at the dorsal angle. Length of hypotype 0.52 mm. breadth 0.12 mm., thickness 0.06 mm.

Type.—Hypotype from locality HTL-13, sample 119.

Remarks.—This species is somewhat similar in outline to *Vaginulina kochii* Roemer, but differs in the much smaller and more delicate test and in possessing depressed rather than raised sutures. It is here referred to the early stage of *Flabellinella delicata* Loeblich and Tappan, which it closely resembles. The original description of *Flabellinella delicata* stated that

... no *Vaginulina* similar to the early stages of this species has been found to occur with it. While this species occurs in the Duck Creek formation, a *Vaginulina* similar to its early stage occurs in the much younger Paw Paw formation, but no *Flabellinella* stage is found in the Paw Paw, comparable to the Duck Creek species.

The present specimen and a few others have since been found and may represent the early *Vaginulina* stage of the species, although no adult *Flabellinella delicata* has been found with an early *Vaginulina* stage of a length equal to that of the free *Vaginulina*-like forms. Perhaps the latter are megalospheric tests, and only the microspheric tests show the complete development.

FLABELLINELLA PLANA Loeblich and Tappan

Flabellinella plana LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 19, pl. 2, figs. 13-15.

Types.—Holotype and paratypes from locality HTL-38, sample 224; paratypes also from locality HTL-35, sample 277; and from the middle Duck Creek at localities HTL-13 and HTL-27, the lower and middle Duck Creek at locality HTL-34, and the lower Duck Creek at localities HTL-57 and HTL-60.

FLABELLINELLA PLANA STRIATA Loeblich and Tappan

Flabellinella plana striata LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 21, pl. 2, fig. 16.

Types.—Holotype from locality HTL-13, sample 119; paratype from locality HTL-34, sample 215.

FLABELLINELLA? sp. Loeblich and Tappan

Flabellinella? sp. LOEBLICH and TAPPAN, 1941, Bull. Am. Paleontology, vol. 26, no. 99, p. 21, pl. 3, fig. 1.

Types.—Hypotypes from locality HTL-13, sample 119, and locality HTL-34, sample 210.

Subfamily LAGENINAE

Genus LAGENA Walker and Jacob, 1798

LAGENA APICULATA (Reuss)

Plate 80, figure 31

Oolina apiculata REUSS, 1850, Haidinger's Nat. Abhandl., vol. 4, p. 22, pl. 1, fig. 1.

Lagena apiculata, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 111, pl. 17, figs. 15a, b. Includes additional synonymy.

Test tiny, consisting of a single ovate chamber, widest toward the base, with an initial spine; wall calcareous, surface smooth; aperture rounded, terminal, at the end of a short, wide neck. Length of hypotype 0.34 mm., breadth 0.18 mm.

Type.—Hypotype from locality HTL-35, sample 215.

Remarks.—This species occurs throughout the Washita group and has been widely recorded from other strata.

LAGENA STRIATIFERA Tappan

Plate 80, figures 32a, b

Lagena striatifera TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 112, pl. 17, figs. 18a, b.

Test tiny, consisting of a single ovate chamber, widest slightly below the center with a blunt basal spine; wall calcareous, surface ornamented with about 28 very fine, low ribs; aperture terminal, simple, at the end of a short broad neck. Length of hypotype 0.25 mm., breadth 0.16 mm.

Type.—Hypotype from locality HTL-13, sample 113.

Remarks.—This species was originally described from the Grayson formation and the geologic range is here extended downward to include the Duck Creek formation.

LAGENA SULCATA (Walker and Jacob)

Plate 80, figures 33–34b.

Serpula (Lagena) sulcata WALKER and JACOB, 1798, Adam's Essays, Kanmacher's Edit., p. 634, pl. 14, fig. 5.

Lagena sulcata, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 112, pl. 17, figs. 19a, b. Includes additional synonymy.

Test tiny, consisting of a single flask-shaped chamber; wall calcareous, surface ornamented by 10 to 12 longitudinal ribs, usually with a basal spine as well; aperture radiate, at the end of a long neck, the base of which may be somewhat thickened and striate, but both neck and basal spine may be broken away. Length of hypotype in figure 33, 0.24 mm., breadth 0.17 mm.; length of hypotype in figure 34, 0.18 mm., breadth 0.15 mm.

Types.—Hypotype of figure 33 from sample 218, hypotype of figure 34 from sample 214, both from locality HTL-34.

Remarks.—This species ranges throughout the Washita group and has also been widely recorded elsewhere.

Family POLYMORPHINIDAE

Subfamily POLYMORPHININAE

Genus PALEOPOLYMORPHINA Cushman and Ozawa, 1930

PALEOPOLYMORPHINA OZAWAI Tappan
Plate 80, figure 35

Paleopolymorphina ozawai TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 113, pl. 17, figs. 20a–21c.

Test tiny, slightly elongate, early chambers spiral, later ones biserial, chambers inflated, elongate, later ones generally much enlarged, overhanging over earlier chambers; sutures indistinct in early portion, in biserial portion distinctly depressed; wall calcareous, surface smooth; aperture radiate, terminal. Length of hypotype 0.29 mm., breadth 0.15 mm., thickness 0.11 mm.

Type.—Hypotype from locality HTL-34, sample 218.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation.

Genus GLOBULINA d'Orbigny, 1839

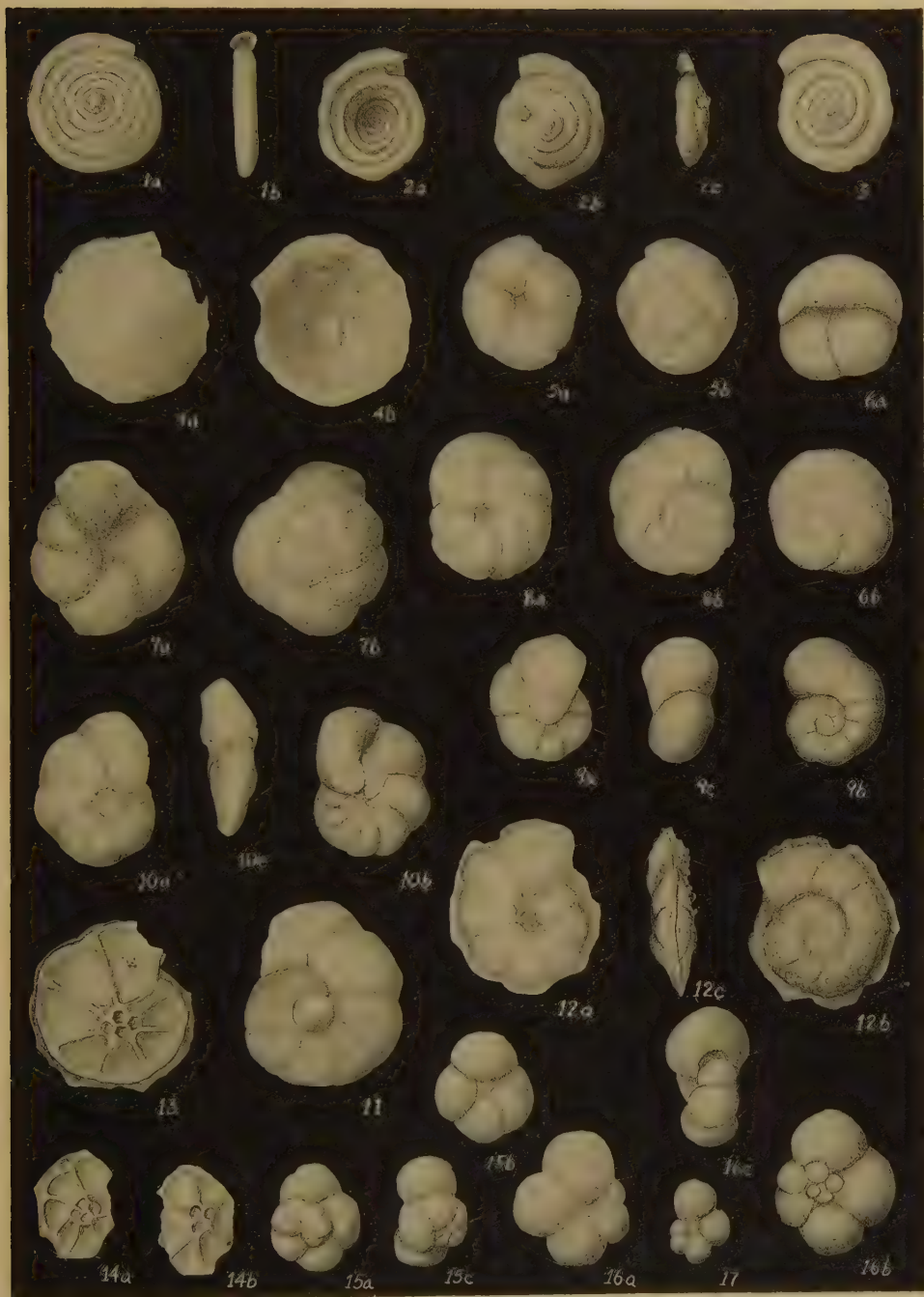
GLOBULINA EXSERTA (Berthelin)

Plate 80, figures 36a–37

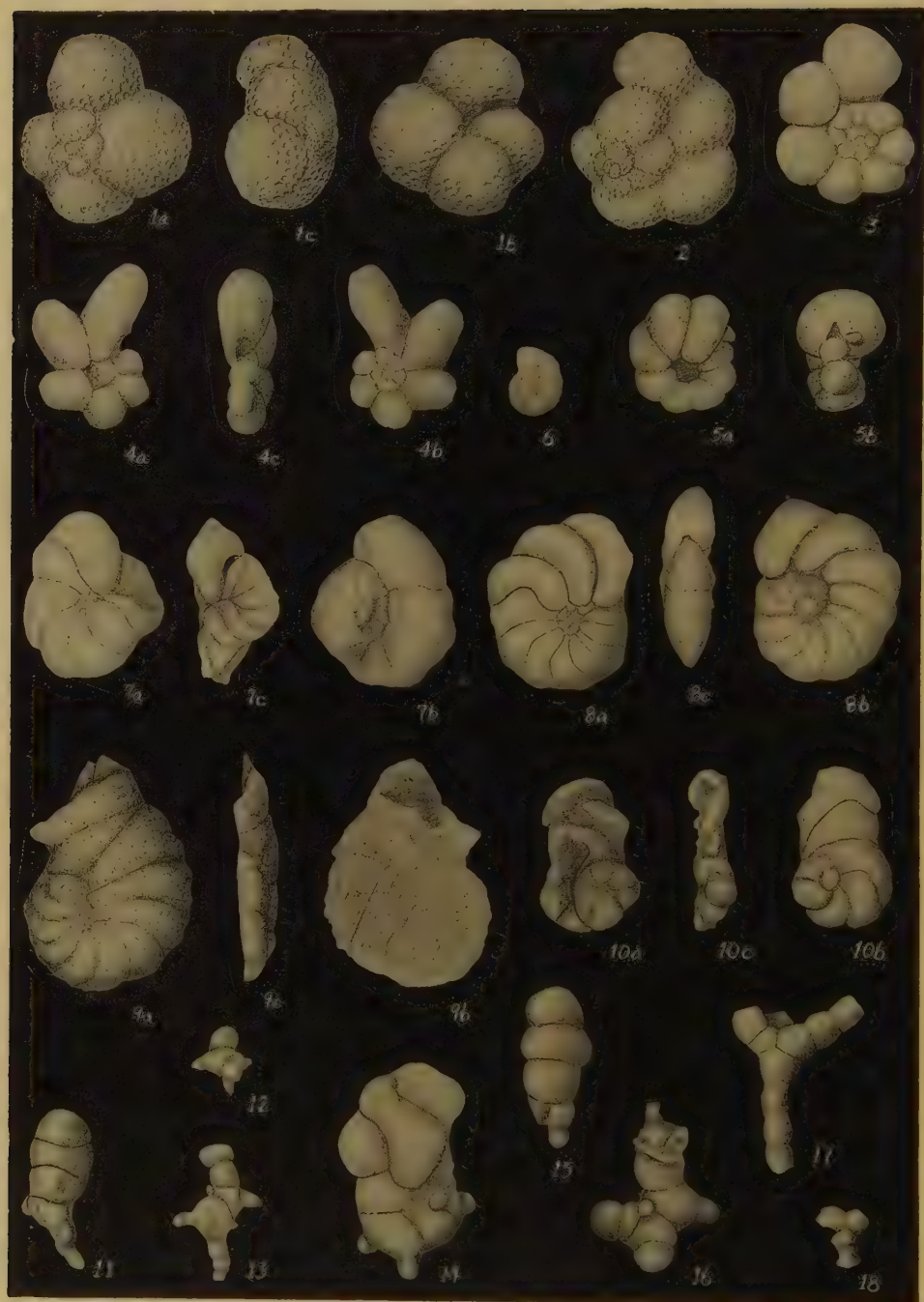
Polymorphina exserta BERTHELIN, 1880, Soc. géol.

EXPLANATION OF PLATE 82
Families Spirillinidae to Globigerinidae

- FIG. 1—*Spirillina minima* Schacko. 1a, Side view, 1b, edge view, $\times 76$. (p. 510)
 2, 3—*Turrispirillina subconica* Tappan, n. sp. 2a, 2b, Side views of holotype, 2c, edge view, $\times 53$. (p. 510)
 3, Side view of paratype, $\times 76$.
 4—*Patellina subcretacea* Cushman and Alexander. 4a, Dorsal view, 4b, ventral view, $\times 128$. (p. 511)
 5, 6—*Discorbis minutissima* Tappan, n. sp. 5, Holotype, 6, paratype, 5a, 6a, ventral views, 5b, 6b, dorsal views, $\times 117$. (p. 511)
 7, 8—*Discorbis minima* Vieaux. 7a, 8a, Ventral views, 7b, 8b, dorsal views, $\times 53$. (p. 511)
 9—*Gyroidina loetterlei* Tappan. 9a, Ventral view, 9b, dorsal view, 9c, edge view, $\times 76$. (p. 512)
 10, 11—*Valvulineria asterigerinoides* Plummer. 10a, 11, Dorsal views, 10b, ventral view, 10c, edge view, $\times 53$. (p. 511)
 12—*Epistomina lenticularia* Tappan, n. sp. 12a, Ventral view of holotype, 12b, dorsal view, 12c, edge view, $\times 27$. (p. 512)
 13, 14—*Epistomina limbata* Tappan, n. sp. 13, Paratype, 14, holotype, $\times 27$. (p. 512)
 15—*Globigerina graysonensis* Tappan. 15a, Dorsal view, 15b, ventral view, 15c, edge view, $\times 117$. (p. 513)
 16, 17—*Globigerina cretacea* d'Orbigny. 16a, Ventral view, 16b, 17, dorsal views, 16c, edge view, $\times 53$. (p. 512)



Tappan, Lower Cretaceous (Duck Creek) Foraminifera



Tappan, Lower Cretaceous (Duck Creek) Foraminifera

France Mém., sér. 3, t. 1, no. 5, p. 57, pl. 4, figs. 22a-23b.

Polymorphina bucculenta BERTHELIN, 1880, idem, p. 58, pl. 4, figs. 16a-17b.

Globulina exserta, CUSHMAN and OZAWA, 1930, U. S. Nat. Mus. Proc., vol. 77, art. 6, p. 78, pl. 19, figs. 5-7.

Test medium to small, ovate, initial end usually somewhat produced; chambers slightly inflated, arranged in a nearly triserial series; sutures vary from slightly depressed to indistinct; wall calcareous, surface smooth; aperture radiate, terminal. Length of hypotype in figure 36, 0.31 mm., breadth 0.15 mm.; length of hypotype in figure 37, 0.45 mm., breadth 0.23 mm.

Types.—Hypotypes from locality HTL-13, sample 112.

Remarks.—The hypotypes here figured are somewhat smaller than the limits given by Cushman and Ozawa but are similar in all other features. They are representative of the two variations found by Berthelin, the specimen in figure 12 being the type which he named *Polymorphina exserta*, that of figure 13 being the type called *P. bucculenta*. Cushman and Ozawa did not consider the variation in the two types to be of specific rank, and therefore, combined them under Berthelin's specific name of *exserta*, changing the generic designation to *Globulina*. They list the species as very common in the Cretaceous of England and France and have also recorded it from the Goodland formation (Fredericksburg group) of northern Texas. The range is here extended upward into the Duck Creek formation of the Washita group.

GLOBULINA REDRIVERENSIS Tappan,
n. sp.

Plate 81, figures 1a-3

Test large, early portion free, more or less compressed, ovate in outline, later portion attached and consisting of a fistulose growth beginning at the aperture of the globuline portion and spreading widely over the attachment, irregularly bifurcating at intervals; chambers arranged in a nearly triserial series, elongate, slightly inflated; sutures of globuline portion obscure or faintly depressed; wall calcareous, surface smooth; aperture at the open ends of the attached tubular growth. Length of holotype 2.02 mm., length of globuline portion 0.50 mm., greatest breadth 0.30 mm.; length of globuline portion of paratype in figure 3, 0.51 mm., breadth 0.22 mm.; length of globuline portion of paratype in figure 2, 0.65 mm., breadth 0.29 mm.

Types.—Holotype and paratype of figure 2 from sample 120, paratype of figure 3 from sample 117, all from locality HTL-13.

Remarks.—This species differs from *G. exserta* (Berthelin) in the attached character, in the somewhat more elongate globuline portion, and in the presence of the very elongate, branching fistulose growth. Attached species of the Polymorphininae are extremely rare, probably less than half a dozen having been recorded to date. The attached area of *Globulina redriverensis* is elongate and quite conspicuous, and thus differs from that of the earlier described attached species, all of which have only an

EXPLANATION OF PLATE 83

Families Globigerinidae to Anomalinidae

- FIGS. 1, 2—*Globigerina washitensis* Carsey. 1a, 2, Dorsal views, 1b, ventral view, 1c, edge view, ×53. (p. 513)
 3—*Globigerina planispira* Tappan. ×53. (p. 513)
 4—*Hastigerinella subcretacea* Tappan, n. sp. 4a, Ventral view of holotype, 4b, dorsal view, 4c, edge view, ×53. (p. 513)
 5—*Globigerinella cushmani* Tappan, n. sp. 5a, Side view of holotype, 5b, edge view, ×53. (p. 513)
 6-8—*Anomalina plummerae* Tappan. 6, 7b, 8b, Dorsal views, 7a, 8a, ventral views, 7c, 8c, edge views, ×35. (p. 514)
 9, 10—*Stichocibicides subcretacea* Tappan, n. sp. 9, Holotype, microspheric, ×53. 10, Paratype, megalospheric, ×46. 9a, 10b, Ventral views, 9b, 10a, dorsal views, 9c, 10c, edge views. (p. 514)
 11-16—*Washitella typica* Tappan, n. gen., n. sp. 11, 12, 15, Paratypes, ×35. 13, Holotype, ×35. 14, 16, Paratypes, ×53. (p. 515)
 17, 18—*Washitella triradiata* Tappan, n. sp. 17, Holotype, 18, paratype, ×53. (p. 515)

ovate, flattened area of small size surrounding the earlier portion of the test. Examples of this type are *Guttulina lactea earlandi* Cushman and Ozawa, *Globulina inaequalis doffussi* Cushman and Ozawa and *Sigmomorphina concava* (Williamson). In *Globulina dentimarginata* (Chapman) the attached growth is septate, although still only a flattened platelike area.

The specific name refers to the type locality, in the banks of the Red River, Love County, Oklahoma.

Genus PSEUDOPOLYMORPHINA Cushman
and Ozawa 1928

PSEUDOPOLYMORPHINA ROANOKENSIS
Tappan

Plate 81, figures 4, 5

Pseudopolymorphina roanokensis TAPPAN, 1940,
Jour. Paleontology, vol. 14, no. 2, p. 113, pl.
17, figs. 22a-23, 25.

Test small, elongate, narrow, early portion at first globuline, later becoming uniserial; sutures indistinct; wall calcareous, surface smooth or very finely hispid; aperture invariably obscured by fistulose growth consisting of a number of long, irregular, tapering tubes of various lengths, which are frequently broken. Length of hypotype in figure 4, 0.36 mm., breadth just below fistulose growth 0.08 mm., greatest breadth across fistulose extensions 0.41 mm.; length of hypotype in figure 5, 0.42 mm.

Types.—Hypotypes from locality HTL-13, sample 120.

Remarks.—This species was originally described from the Grayson formation and the range is here extended downward to include the Duck Creek formation.

Subfamily RAMULININAE

Genus RAMULINA Rupert Jones, 1875

RAMULINA ACULEATA Wright

Plate 81, figures 6, 7

Ramulina aculeata WRIGHT, 1886, Belfast Nat.
Field Club Rept. Proc., p. 331, pl. 27, fig. 11.

Ramulina aculeata, BURROWS, SHERBORN and
BAILEY, 1890, Royal Micr. Soc. Jour., p. 561,
pl. 11, fig. 16.

Ramulina aculeata, CHAPMAN, 1896, idem, p. 583,
pl. 12, figs. 7-9.

Ramulina aculeata, EICHENBERG, 1933, Nieder-
sächs. geol. Vereins zu Hannover Jahresb. 25,
Teil 1, Folge 1, p. 18, pl. 6, figs. 6a, b; 1935,
Roemer-Mus. Mitteil. no. 37, Teil 1, Folge 4,
p. 29, pl. 6, fig. 1.

Test free, medium-sized, consisting of globular chambers and branching stoloniferous tubes, globular chambers increasing in size somewhat as added, inflated centrally with distinct and constricted sutures; wall calcareous, surface covered with fine or somewhat larger blunt spines; aperture a rounded opening at the end of the chamber or the open end of the stoloniferous tubes. Length of hypotype of figure 6, 0.77 mm., greatest breadth of largest chamber 0.41 mm.; length of hypotype of figure 7, 1.4 mm., greatest breadth 0.29 mm.

Types.—Hypotype of figure 6 from locality HTL-57, sample 295; hypotype of figure 7 from locality HTL-13, sample 113.

Remarks.—This species occurs in the Gault of England and Germany and is here recorded from the Duck Creek of Texas and Oklahoma. Specimens of both the tubular and globular types have been figured by both Chapman and Eichenberg.

RAMULINA GLOBULIFERA Brady

Plate 81, figures 8, 9

Ramulina globulifera BRADY, 1884, Rept. Voy.
Challenger, Zoology, vol. 9, p. 587, pl. 76, figs.
22-28.

Ramulina globulifera, CHAPMAN, 1896, Royal
Micr. Soc. Jour., p. 582, pl. 12, figs. 5, 6.

Ramulina cf. *globulifera*, TAPPAN, 1940, Jour.
Paleontology, vol. 14, no. 2, p. 114, pl. 18,
fig. 3.

Test medium-sized, consisting of a subglobular inflated area opening out into numerous tubular projections, which occasionally bifurcate; wall calcareous, surface occasionally very finely hispid; apertures at the open ends of the tubes. Length of hypotype in figure 16, 0.51 mm., greatest thickness 0.14 mm.; length of hypotype in figure 17, 0.57 mm., greatest breadth 0.19 mm.

Types.—Hypotypes from locality HTL-13, sample 113.

Remarks.—This species ranges throughout the Washita group and has been recorded from the Cretaceous to the Recent.

Genus BULLOPORA Quenstedt, 1856

BULLOPORA CERVICORNIS (Chapman)

Plate 81, figure 10

Polymorphina orbignyii var. *cervicornis* CHAPMAN,
1892, Geol. Mag., n. ser., dec. 3, vol. 9, p. 54,
pl. 2, figs. 5, 6.

Ramulina cervicornis, CHAPMAN, 1896, Royal Micr. Soc. Jour., p. 584, pl. 12, figs. 10, 11.

Vitriwebbina cervicornis, EICHENBERG, 1934, Niedersächs. geol. Vereins zu Hannover Jahresb. 26, p. 184, pl. 16, fig. 2.

Bullopore cervicornis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 114, pl. 18, fig. 5.

Test large, an elongate attached tube, much inflated, bifurcating occasionally, with the branching dichotomous; wall calcareous, surface smooth; apertures at the open ends of the tubes. Greatest breadth of hypotype 1.93 mm., greatest breadth of single tube, 0.26 mm.

Type.—Hypotype from locality HTL-34, sample 214.

Remarks.—This species was originally described from England and has been recorded from Germany and from the Grayson formation of Texas. The range is here extended downward to include the Duck Creek formation.

BULLOPORA LAEVIS (Sollas)

Plate 81, figures 11, 12

Vitriwebbina laevis SOLLAS, 1877, Geol. Mag., n. ser., dec. 2, vol. 4, no. 3, p. 103, pl. 6, figs. 1-3.

Vitriwebbina laevis, CHAPMAN, 1892, idem, dec. 3, vol. 9, p. 54, pl. 2, fig. 4; 1896, Royal Micr. Soc., Jour., p. 585, pl. 12, fig. 12.

Bullopore laevis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 115, pl. 18, fig. 6.

Test medium-sized to large, attached, chambers ovate or rounded in outline, inflated, occasionally possessing a raised central bulb; aperture at the end of a stoloniferous neck. Length of hypotype in figure 11, 0.71 mm., greatest breadth 0.37 mm.; length of hypotype in figure 12, 1.04 mm., breadth 0.72 mm.

Types.—Hypotype of figure 11 from sample 117, hypotype of figure 12 from sample 119, both from locality HTL-13.

Remarks.—This species was originally described from England and has been recorded also from the Grayson formation of Texas. The geologic range is here extended downward to include the Duck Creek formation.

Family HETEROHELICIDAE

Subfamily GÜMBELININAE

Genus GÜMBELITRIA Cushman, 1933

GÜMBELITRIA HARRISI Tappan

Plate 81, figures 13-14b

Gümbelitra harrisi TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 115, pl. 19, figs. 2a-b.

Test minute, triserial, flaring; chambers becoming more inflated and globular as added; sutures distinctly depressed; wall calcareous, surface smooth; aperture low, at the base of the last-formed chamber. Length of hypotype of figure 13, 0.11 mm., breadth 0.10 mm.; length of hypotype of figure 14, 0.17 mm., breadth 0.14 mm.

Types.—Hypotypes from locality HTL-60, sample 300.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation.

Family BULIMINIDAE

Subfamily BULIMININAE

BULIMINA NANNINA Tappan

Plate 81, figure 15

Bulimina nannina TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 116, pl. 19, figs. 4a, b.

Test tiny, triserial; chambers inflated, earliest chambers very small, increasing rapidly in size, last chamber extending back about one-half the length of the test; sutures distinct, depressed; wall calcareous, surface smooth; aperture loop-shaped, in the face of the last formed chamber. Length of hypotype 0.17 mm., breadth 0.12 mm.

Types.—Hypotype from locality HTL-13, sample 114.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation.

Genus NEOBULIMINA Cushman and

Wickenden, 1928

NEOBULIMINA MINIMA Tappan

Plate 81, figures 16a-b

Neobulimina minima TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 117, pl. 19, figs. 5a-6.

Test very tiny, slender, tapering, nearly circular in cross section, early stage triserial, later biserial, final pair of chambers covering about one-third the length of the test; chambers twisted somewhat about the axis of the test, inflated, slightly elongate; wall calcareous, surface smooth; aperture broad, loop-shaped, at the base of the last-formed chamber. Length of hypotype 0.15 mm., breadth 0.05 mm.

Type.—Hypotype from locality HTL-27, sample 165.

Remarks.—This species was originally described from the Grayson formation and the range is here extended downward to include the Duck Creek formation.

Subfamily VIRGULININAE

Genus VIRGULINA d'Orbigny, 1826

VIRGULINA CRONEISI Tappan, n. sp.

Plate 81, figures 17a-18

Test minute, broad, flattened; chambers biserially arranged and twisted slightly about the center, inflated, elongate and increasing rapidly in size, the last-formed two chambers covering three-fifths or more of the length of the test, the basal margins of the successive chambers being truncate and standing out over the preceding; sutures distinctly depressed, oblique; wall calcareous, surface smooth; aperture loop-shaped, in the face of the last-formed chamber. Length of holotype 0.22 mm., breadth 0.11 mm., greatest thickness 0.08 mm.; length of paratype 0.13 mm., breadth 0.08 mm., thickness 0.04 mm.

Types.—Holotype and paratype from locality HTL-60, sample 303. Paratypes also from the Fort Worth formation.

Remarks.—This species differs from *V. minuta* Cushman in the much more elongate and overhanging chambers, in the fewer chambers and in their truncate bases, which extend out over the preceding ones. The sutures are more oblique and the proloculum elongate rather than rounded. The character of the chambers is somewhat similar to that of *V. marginata* Heron-Allen and Earland, but *V. croneisi* differs in the smaller size, much broader and more flattened test, and the comparatively large later chambers.

VIRGULINA MINUTA Cushman

Plate 81, figures 19, 20

Virgulina minuta CUSHMAN, 1936, Cushman Lab. Foram. Research Spec. Pub. 6, p. 47, pl. 7, figs. 3a-c; 1937, idem, Spec. Pub. 9, p. 4, pl. 1, figs. 6, 7.

Virgulina minuta, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 117, pl. 19, figs. 7a, b.

Test tiny, elongate, tapering gradually, base rounded, in the adult the sides becoming subparallel, periphery slightly lobulate,

broadly rounded; chambers numerous, increasing gradually in size, inflated; sutures distinct, depressed, oblique; wall calcareous, surface smooth; aperture narrow, elongate, at the inner margin of the last-formed chamber. Length of hypotype of figure 20, 0.23 mm., breadth 0.17 mm., thickness 0.08 mm.

Type.—Hypotypes from locality HTL-27, sample 169.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation. The species is distinguished by its small size, very gradually enlarging chambers, and very slight degree of twisting.

Subfamily UVIGERININAE

Genus UNICOSIPHONIA Cushman, 1935

UNICOSIPHONIA SUBCRETACEA Tappan, n. sp.

Plate 81, figures 21a-c

Test medium-sized, elongate, narrow, uniserial, straight or slightly arcuate; chambers numerous, increasing slightly in breadth, more rapidly in height, crenulate at the margin with about six backwardly projecting, somewhat overlapping processes, giving a subhexagonal test; sutures distinct, depressed; wall calcareous, finely perforate; aperture rounded, terminal. Length of holotype 1.23 mm., breadth 0.13 mm.

Type.—Holotype from locality HTL-57, sample 295.

Remarks.—This genus has formerly been known only from the Tertiary, and the range is here extended downward to include the Lower Cretaceous. *Unicosiphonia subcretacea* differs from *U. crenulata* Cushman in the more elongate and tapering test, higher chambers and fewer backward projections. The aperture of the holotype of *U. subcretacea* appears elongate, but this is probably due to compression, as the last chamber is somewhat crushed. The type of the genus also had a more distinct neck and an internal tubular structure connecting with the former apertures. Unfortunately many of the Lower Cretaceous specimens of Foraminifera are filled with calcite so that the internal structure is obscured, and it is not possible to determine the presence or absence of this structure in *U. subcretacea* with the material at present available.

Genus DENTALINOPSIS Reuss, 1860
DENTALINOPSIS CHAPPARSI Tappan,
n. sp.

Plate 81, figures 26–28b

Test small, elongate, narrow, subtriangular in section; chambers increasing very gradually in breadth from the globular proloculum, increasing more rapidly in height, later ones quite high, sides gently convex, angles rounded, their position best shown by the chambers, which are arched on the sides and curve sharply down the angles of the test; sutures distinct, depressed; wall calcareous, surface smooth; aperture terminal, rounded. Length of holotype 0.455 mm., breadth 0.09 mm.; length of paratype in figure 26, 0.51 mm., breadth 0.09 mm.; length of paratype in figure 27, 0.50 mm., breadth 0.10 mm.

Types.—Holotype and paratype of figure 27 from locality HTL-57, sample 295; paratype of figure 26 from locality HTL-13, sample 114.

Remarks.—This species differs from *Dentalinopsis excavata* (Reuss) in the much narrower test, poorly defined angles, higher chambers and less arched sutures.

DENTALINOPSIS EXCAVATA (Reuss)

Plate 81, figure 22

Rhabdogonium excavatum REUSS, 1862, Akad. Wiss. Wien. Sitzungsber., Band 46, p. 91, pl. 12, figs. 8a–c.

Dentalinopsis excavata, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 118, pl. 18, figs. 10a, b. Includes additional synonymy.

Test elongate, broad, uniserial, triangular in section, angles subacute; faces nearly flat; chambers numerous, low, increasing gradually in size; sutures distinct but not depressed; wall calcareous, surface smooth; aperture terminal, rounded. Length of hypotype 0.67 mm., breadth 0.28 mm.

Type.—Hypotype from locality HTL-60, sample 303.

Remarks.—This species differs from the typical *D. excavata* (Reuss) in the somewhat larger and comparatively broader test, and in the flat rather than concave faces. *D. excavata* ranges throughout the Washita group.

DENTALINOPSIS MÄRTENSI (Reuss)

Plate 81, figure 23a–b

Rhabdogonium märtensi REUSS, 1863, Akad. Wiss.

Wien Sitzungsber., Band 46, p. 56, pl. 5, fig. 4. *Rhabdogonium maertensi*, CHAPMAN, 1894, Royal Micr. Soc. Jour., p. 160, pl. 4, figs. 10a, b. *Dentalinopsis märtensi*, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 119, pl. 18, figs. 11a–c.

Test small, uniserial, narrow, elongate, quadrate in section, angles bluntly rounded; chambers curved downward at the angles, increasing in height as added by expanding very slightly so that the sides of the test are nearly parallel; sutures distinct, very slightly depressed, highly arched in the middle of each side; wall calcareous, surface smooth; aperture terminal, rounded. Length of hypotype 0.43 mm., breadth 0.16 mm.

Type.—Hypotype from locality HTL-13, sample 116.

Remarks.—This species occurs throughout the Washita group but not abundantly.

DENTALINOPSIS NODOSARIA Tappan,
n. sp.

Plate 81, figure 24

Test elongate, narrow, medium-sized, subtriangular in section, chambers high, extending downward at the broadly rounded angles, which twist about one-third of the way around the test in a distance of about six chambers, last chamber rounded in section, faces slightly convex; sutures distinct, depressed, arched slightly upward in the center of the faces, downward at the angles of the test; wall calcareous, surface smooth; aperture terminal, rounded. Length of holotype 0.63 mm., breadth 0.15 mm.

Type.—Holotype from locality HTL-34, sample 218.

Remarks.—This species differs from *D. excavata* (Reuss) in the longer and narrower test, higher chambers, and slightly convex rather than excavated faces, and in the less arched sutures and rounded angles.

DENTALINOPSIS QUADRATA Vieaux

Plate 81, figures 25a–b

Dentalinopsis quadrata VIEAUX, 1941, Jour. Paleontology, vol. 15, no. 6, p. 626, pl. 85, figs. 8a, b.

Test medium-sized, quadrate in section, flaring; chambers increasing gradually in size, sides moderately excavated, angles sharp; sutures distinct, slightly depressed; wall calcareous, surface smooth; aperture

terminal, rounded. Length of holotype 0.78 mm., breadth 0.29 mm., thickness from center of face to center of opposite face 0.22 mm.

Type.—Hypotype from locality HTL-13, sample 121.

Remarks.—This species differs from *D. märtensi* (Reuss) in the larger and broader and slightly flaring test, and more deeply excavated sides and sharp angles.

Dentalinopsis quadrata Vieaux was originally described from the Denton formation, and the range is here extended downward to include the Duck Creek formation.

DENTALINOPSIS TRICARINATUM
ACUTANGULUM Reuss
Plate 81, figures 29a-c

Rhabdogonium tricarinatum acutangulum REUSS, 1863, Akad. Wiss. Wien Sitzungsber., Band 46, p. 55, pl. 4, figs. 14a, b.

Rhabdogonium tricarinatum acutangulum, CHAPMAN, 1894, Royal Micr. Soc. Jour., p. 159, pl. 4, figs. 8a, b.

Rhabdogonium tricarinatum acutangulum, SCHMITT, 1929, Zeitsch. f. Geschiebeforschung, Band 5, Heft 3, pl. 5, figs. 15, 15a.

Dentalinopsis tricarinatum acutangulum, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 119, pl. 18, figs. 13a-c.

Test medium-sized, uniserial, triangular in section, flaring; chambers low and broad, increasing very slightly in height as added, faces of test deeply excavated, angles sharp and acute; sutures distinct, depressed; wall calcareous, surface smooth; aperture terminal, rounded. Length of hypotype 0.54 mm., breadth 0.27 mm., distance from center of one face to tip of opposite angle 0.20 mm.

Type.—Hypotype from locality HTL-13, sample 120.

Remarks.—This species is distinguished by the very deeply excavated faces and regularly flaring test. It ranges throughout the Washita group.

Family SPIRILLINIDAE
Subfamily SPIRILLININAE
Genus SPIRILLINA Ehrenberg, 1843
SPIRILLINA MINIMA Schacko
Plate 82, figures 1a, b

Spirillina minima SCHACKO, 1892, Foram. u. Ostra. a. d. Kreide von Moltzow, p. 159, pl. 1, fig. 4.

Spirillina minima, FRANKE, 1928, Preuss. geol. Landesanstalt Abh., n. ser., Band 111, p. 16, pl. 1, fig. 16.

Spirillina minima, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 119, pl. 19, fig. 8.

Test small, discoidal, planispiral; proloculum comparatively large, globular, second chamber undivided, tubular, closely coiled, with about six volutions in well-developed tests; spiral suture distinct; wall calcareous, surface smooth; aperture formed by the open end of the tube. Greatest diameter of hypotype 0.26 mm., thickness 0.05 mm.

Type.—Hypotype from locality HTL-60, sample 303.

Remarks.—This species was originally described from Germany and has been recorded from the Grayson and Denton formations of this country. The range is here extended downward to include the Duck Creek formation.

Subfamily TURRISPIRILLININAE
Genus TURRISPIRILLINA Cushman, 1927
TURRISPIRILLINA SUBCONICA Tappan,
n. sp.
Plate 82, figures 2a-3

Test small, conical, coiled; proloculum small and rounded, followed by an elongate tubular second chamber in a low and hollow conical spire, coils evolute, usually five to six volutions; spiral suture distinct, tubular second chamber nonseptate; wall calcareous, surface smooth; aperture formed by the open end of the tube. Greatest diameter of holotype 0.36 mm., least diameter 0.27 mm., height of spire 0.09 mm.; greatest diameter of paratype 0.25 mm., least diameter 0.21 mm., height of spire 0.05 mm.

Types.—Holotype from locality HTL-34, sample 216; paratype from locality HTL-13, sample 114.

Remarks.—This species differs from *Turrispirillina conoidea* (Paalzow) in the lower spire, the coiling being less involute ventrally, and the test less coarsely perforate. The spire of *T. subconica* is not as distinct in side view as it would appear in section, due to the fairly rapid increase in size of the whorl. The conical appearance is most evident ventrally, due to the deep ventral excavation.

Family ROTALIIDAE

Subfamily DISCORBINAE

Genus PATELLINA Williamson, 1858

PATELLINA SUBCRETACEA Cushman and
Alexander

Plate 82, figures 4a, b

Patellina subcretacea CUSHMAN and ALEXANDER,
1930, Cushman Lab. Foram. Research Contr.,
vol. 6, p. 10, pl. 3, figs. 1a, b.

Test small, scalelike, in a low spire, ventral side concave, dorsal side slightly convex; early portion consisting of an elongate, spiral undivided tubular chamber of several coils, later chambers narrow and elongate, about two to each whorl; sutures not depressed; wall calcareous, thin, translucent, surface smooth; aperture elongate, at the base of the ventral side of the chamber. Greatest diameter of hypotype 0.26 mm., least diameter 0.25 mm., height of spire 0.08 mm.

Type.—Hypotype from locality HTL-34, sample 212.

Remarks.—This species was originally described from the Goodland formation (Fredericksburg group) and has also been recorded in a faunal list from the Denton formation.

Genus DISCORBIS Lamarck, 1804

DISCORBIS MINIMA Vieaux

Plate 82, figures 7a–8b

Discorbis minima VIEAUX, 1941, Jour. Paleontology, vol. 15, no. 6, p. 627, pl. 85, figs. 10a–c.

Test medium-sized, trochoid, plano-convex, ventral side flattened and umbilicate; chambers increasing rapidly in size, about five to seven chambers in the last volution; sutures distinct, depressed, convex toward the aperture, curving backwards at the periphery; wall calcareous, coarsely perforate; aperture at the base of the umbilical margin of the last-formed chamber on the ventral side. Greatest diameter of hypotype of figure 7, 0.47 mm., least diameter 0.36 mm., greatest thickness 0.21 mm.; greatest diameter of hypotype of figure 8, 0.37 mm., least diameter 0.31 mm., greatest thickness 0.14 mm.

Types.—Hypotypes from locality HTL-13, sample 119.

Remarks.—This species was originally

described from the Denton and Fort Worth formations, and the range is here extended downward to include the Duck Creek formation.

DISCORBIS MUNUTISSIMA Tappan,

n. sp.

Plate 82, figures 5, 6

Test tiny, planoconvex, trochoid, ventral side flattened, umbilicate; chambers increasing rapidly in size; sutures indistinct, very slightly depressed, oblique and curved dorsally, nearly straight on the ventral side; wall calcareous, finely perforate; aperture at the base of the ventral side of the last-formed chamber. Greatest diameter of holotype 0.16 mm., least diameter 0.13 mm., height 0.08 mm.; greatest diameter of paratype 0.15 mm., height 0.08 mm.

Types.—Holotype and paratype from locality HTL-60, sample 301.

Remarks.—This species differs from *D. minima* Vieaux, in its more minute size and fewer chambers in a volution.

Genus VALVULINERIA Cushman, 1926

VALVULINERIA ASTERIGERINOIDES

Plummer

Plate 82, figures 10a–11

Valvulineria asterigerinoides PLUMMER, 1931,
Texas Univ. Bull. 3101, p. 190, pl. 14, fig. 6.*Valvulineria asterigerinoides*, TAPPAN, 1940, Jour.
Paleontology, vol. 14, no. 2, p. 120, pl. 19,
figs. 9a–c.

Test small, trochoid, biconvex, periphery rounded, slightly lobulate; chambers increasing gradually in size, with ventral umbilical flaps overlapping and forming a star-shaped area around the umbilicus, about eight chambers in the last volution; sutures distinct, depressed; slightly curved, convex toward the aperture; aperture near the umbilical area, under a posterior flap of the last chamber. Greatest diameter of hypotype of figure 10, 0.37 mm., least diameter 0.29 mm., greatest thickness 0.13 mm.; greatest diameter of hypotype of figure 11, 0.47 mm., least diameter 0.38 mm., greatest thickness 0.18 mm.

Types.—Hypotypes from locality HTL-13, sample 122.

Remarks.—This species was originally

described from the Grayson formation but ranges throughout the Washita group.

Genus *GYROIDINA* d'Orbigny, 1826

GYROIDINA LOETTERLEI Tappan

Plate 82, figures 9a-c

Gyroidina loetterlei TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 120, pl. 19, figs. 10a-c.
Gyroidina nitida (Reuss). PLUMMER, 1931, Texas Univ. Bull. 3101, p. 191, pl. 14, fig. 6.

Test small, trochoid, thick, periphery broadly rounded; chambers increasing gradually in size, last chamber with a broad ventral umbilical flap formed by a posterior extension of the chamber, approximately six chambers in the last volution; sutures distinct, latest ones slightly depressed, nearly straight or very slightly convex toward the aperture, radiating from the center; wall calcareous, surface smooth; aperture a slit at the base of the septal face, extending toward the umbilicus. Greatest diameter of hypotype 0.23 mm., least diameter 0.18 mm., thickness 0.14 mm.

Type.—Hypotype from locality HTL-57, sample 295.

Remarks.—This species ranges abundantly throughout the Washita group.

Subfamily SIPHONININAE

Genus *EPISTOMINA* Terquem, 1883

EPISTOMINA LENTICULARIA Tappan,
n. sp.

Plate 82, figures 12a-c

Test large, trochoid, thinly biconvex, ventrally umbilicate, dorsal side flattened or slightly convex, with a peripheral keel; chambers increasing gradually in size, about eight in the last-formed volution; sutures distinct, slightly curved on the dorsal side, nearly straight ventrally, somewhat thickened; wall calcareous, coarsely perforate; aperture at the inner margin of the ventral side of the last chamber. Greatest diameter of holotype 0.91 mm., least diameter 0.77 mm., thickness 0.22 mm.

Type.—Holotype from locality HTL-34, sample 218.

Remarks.—This species differs from *E. limbata* in the slightly more trochoid character, the depressed, rather than raised sutures, and in lacking the central reticulate area.

EPISTOMINA LIMBATA Tappan, n. sp.

Plate 82, figures 13-14b

Test large, trochoid, biconvex, umbilical area filled; chambers increasing gradually in size, seven to eight in the last volution; sutures distinctly raised and thickened, with early whorls forming a reticulate central area surrounded by highly elevated sutures; wall calcareous; aperture at the inner margin of the ventral side of the chamber. Greatest diameter of holotype 0.55 mm., least diameter 0.38 mm., thickness 0.16 mm.; greatest diameter of paratype 0.87 mm., least diameter 0.83 mm., thickness 0.25 mm.

Types.—Holotype from locality HTL-13, sample 116, paratype from locality HTL-34, sample 218.

Remarks.—This species differs from *E. spinulosa* Reuss in the straighter sutures and somewhat smaller size but is similar in the highly elevated sutures and reticulate central area.

Family GLOBIGERINIDAE

Genus *GLOBIGERINA* d'Orbigny, 1826

GLOBIGERINA CRETACEA d'Orbigny

Plate 82, figures 16a-17

Globigerina cretacea D'ORBIGNY, 1840, Soc. géol. France Mém., sér. 1, t. 4, p. 34, pl. 3, figs. 12-14.

Globigerina cretacea, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 121, pl. 19, figs. 11a-c. Includes additional synonymy.

Test medium-sized, trochoid, periphery broadly rounded; chambers much inflated, globular, four to five in the last volution; sutures distinct, deeply depressed, nearly straight; wall calcareous, surface smooth or very finely hispid; aperture extending from the periphery into the umbilical area. Greatest diameter of hypotype in figure 16 0.35 mm., least diameter 0.31 mm., thickness through last chamber 0.21 mm.; greatest diameter of hypotype of figure 17, 0.20 mm., least diameter 0.14 mm., thickness through last chamber 0.11 mm.

Types.—Hypotypes from locality HTL-13, sample 119.

Remarks.—This species occurs abundantly throughout the Washita group, and has been recorded widely from strata varying in age from Cretaceous to Recent.

Globigerina graysonensis Tappan
Plate 82, figures 15a-c

Globigerina graysonensis TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 122, pl. 19, figs. 15-17.

Test tiny, trochoid, dorsal side varying from slightly convex to a distinct spire, periphery broadly rounded; chambers increasing rapidly in size, inflated, globular, three to five in the last volution; sutures distinct, depressed, slightly curved backwards at the periphery; wall calcareous, surface smooth; aperture slitlike, at the lower margin of the last chamber, ventral in position. Greatest diameter of hypotype 0.13 mm., least diameter 0.12 mm., thickness 0.09 mm.

Type.—Hypotype from locality HTL-60, sample 301.

Remarks.—This species was originally described from the Grayson formation, and the range is here extended downward to include the Duck Creek formation. The species is more common in the upper part of the Washita, however.

Globigerina planispira Tappan
Plate 83, figure 3

Globigerina planispira TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 122, pl. 19, figs. 12a-c.

Test medium-sized to small, flattened, trochoid, about $2\frac{1}{2}$ volutions visible from the dorsal side; chambers numerous, increasing in size as added, globular, much inflated; sutures distinctly depressed, constricted; wall calcareous, surface smooth; aperture at the base of the ventral side of the last formed chamber. Greatest diameter of hypotype 0.44 mm., least diameter 0.33 mm., greatest thickness 0.22 mm., thickness through last chamber 0.20 mm.

Type.—Hypotype from locality HTL-13, sample 112.

Remarks.—This species ranges throughout the Washita group, the specimens of the lower part of the Washita group being larger and better developed.

Globigerina washitensis Carsey
Plate 83, figures 1a-2

Globigerina washitensis CARSEY, 1926, Texas Univ. Bull. 2612, p. 44, pl. 7, fig. 10, pl. 8, fig. 2.

Globigerina washitensis, TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 122, pl. 19, figs. 13a-c. Includes additional synonymy.

Test large, trochoid, bulbous; chambers inflated, increasing rapidly in size, four to six in the last volution, early chambers forming a low trochoid spire; sutures distinctly depressed; wall calcareous, surface covered with coarse reticulations forming a honeycomb pattern; aperture at the base of the last-formed chamber, opening into a deep umbilical excavation. Greatest diameter of hypotype in figure 1, 0.47 mm., least diameter 0.43 mm., greatest thickness 0.29 mm.; greatest diameter of specimen in figure 2, 0.59 mm., least diameter 0.49 mm., greatest thickness 0.37 mm.

Types.—Hypotypes from locality HTL-57, sample 294.

Remarks.—This species occurs throughout the Washita group, specimens from the lower part being larger and more abundant.

Genus *GLOBIGERINELLA* Cushman,
1927

GLOBIGERINELLA CUSHMANI Tappan, n. sp.
Plate 83, figures 5a, b

Test small, planispiral, involute, biumbilicate; chambers increasing rapidly in size, later ones much inflated, about eight in the last volution; sutures distinctly depressed; wall calcareous, surface finely perforate; aperture an arch at the base of the last-formed chamber, on the periphery. Greatest diameter of holotype 0.30 mm., least diameter 0.25 mm., greatest thickness 0.25 mm., least thickness 0.08 mm.

Type.—Holotype from locality HTL-13, sample 120.

Remarks.—This species differs from *Globigerinella aequilateralis* (Brady) in the much smaller size, greater number of chambers per volution, more involute coiling, deep umbilicus, and smooth or pitted rather than spinose surface.

Genus *HASTIGERINELLA* Cushman,
1927

HASTIGERINELLA SUBCRETACEA Tappan,
n. sp.

Plate 83, figures 4a-c

Test small, slightly trochoid, flattened, periphery broadly rounded; chambers numerous, increasing rapidly in size, six to

seven in the last-formed volution, the later chambers much inflated and radially elongated; sutures distinctly depressed; wall calcareous, surface very finely perforate; aperture an arch at the base of the last-formed chamber and slightly ventrally placed on the periphery. Greatest diameter of holotype 0.42 mm., least diameter 0.27 mm., thickness 0.10 mm.

Type.—Holotype from locality HTL-13, sample 120.

Remarks.—This species differs from *H. eocenica* Nuttall in the smaller size, narrower and more numerous chambers, and the more trochoid appearance. It is similar in the comparatively short chambers, for this genus, and in the even size throughout.

Hastigerinella subcretacea is a very primitive species of the genus, and shows many of the characters of *Globigerina* and *Globigerinella*, suggesting the possible origin of the genus *Hastigerinella*.

The genus *Hastigerinella* was formerly known only from the Upper Cretaceous to the Recent, and the generic range is here extended downward into the Lower Cretaceous.

Family ANOMALINIDAE

Subfamily ANOMALININAE

ANOMALINA PLUMMERAE Tappan

Plate 83, figures 6–8c

Anomalina plummerae TAPPAN, 1940, Jour. Paleontology, vol. 14, no. 2, p. 124, pl. 18, figs. 15a–16.

Anomalina petita CARSEY, 1926 (nom. nudum), Texas Univ. Bull. 2612, p. 48 (but not pl. 7, fig. 31, as a cristellarian test was erroneously figured in place of this species).

Anomalina falcata (Reuss). PLUMMER, 1931, Texas Univ. Bull. 3101, p. 202, pl. 14, figs. 7–8.

Test medium-sized, trochoid, compressed, biconvex, periphery subacute; chambers numerous, increasing gradually in size, 9 to 11 occurring in the last volution, center of the dorsal side covered by a conspicuous boss, obscuring the earliest whorls; sutures distinct, depressed, bending backward at the periphery; aperture a low arch over the periphery, extending somewhat ventrally. Greatest diameter of hypotype of fig. 6, 0.28 mm., least diameter 0.22 mm., thickness through center 0.11 mm.; diameter through last chamber of hypotype of figure 7, 0.64 mm., diameter perpendicular to the

preceding, 0.54 mm., thickness through last chamber 0.24 mm.; greatest diameter of hypotype of figure 8, 0.69 mm., least diameter 0.53 mm., thickness through last chamber 0.21 mm.

Types.—Hypotypes all from locality HTL-57, sample 296.

Remarks.—This species ranges abundantly throughout the Washita group. A number of freakish specimens occur, some twinned, and an example is shown in figure 7 of a specimen in which the coiling began in one plane and later chambers added in another, giving a test which appears bent through the center.

Subfamily CIBICIDINAE

Genus STICHOCIBICIDES Cushman and Bermudez, 1936

STICHOCIBICIDES SUBCRETACEA Tappan, n. sp.

Plate 83, figures 9a–10c

Test medium in size, compressed, attached dorsally, ventrally umbilicate, trochoid in early stage, later becoming uniserial, periphery rounded, narrow; chambers numerous, about 10 in the last whorl of the microspheric form, only 6 in the last megalospheric whorl, about 2½ whorls visible dorsally, chambers increasing gradually in size; sutures slightly depressed on the ventral side, strongly curved; wall calcareous, coarsely perforate on the outer side; aperture on the ventral side of the last-formed chamber, near the periphery. Length of holotype 0.53 mm., least diameter of coil 0.40 mm., greatest thickness 0.10 mm.; length of paratype 0.54 mm., breadth of coil 0.29 mm., thickness of coil 0.11 mm., breadth of uniserial portion 0.27 mm., thickness of uniserial portion 0.06 mm.

Type.—Holotype from locality HTL-27, sample 167; paratype from locality HTL-60, sample 301.

Remarks.—The genus *Stichocibicides* has been known only from the Eocene, and the range is here extended downward into the Lower Cretaceous. *Stichocibicides subcretacea* differs from *S. cubensis* Cushman and Bermudez in the comparatively larger coiled portion, greater number of chambers per whorl of the coiled portion, ventral umbilicus, and shorter uniserial stage.

Family unknown

Genus *WASHITELLA* Tappan, n. gen.

Genotype, *Washitella typica* Tappan, n. sp.

Test free, consisting of well-defined but very irregularly arranged chambers; may be in a linear or slightly coiled series or branch in various ways; wall calcareous, finely perforate; apertures at the end of the series of chambers, occasionally more than one.

WASHITELLA TYPICA Tappan,
n. sp.

Plate 63, figures 11–16

Genus? species? TAPPAN, 1940, Jour. Paleontology
vol. 14, no. 2, p. 124, pl. 18, figs. 17a–18b.

Test medium-sized to small, irregular in growth, periphery rounded; chambers numerous, usually with two to four comparatively large chambers in the central portion of the test, arranged in either a linear or somewhat coiled series, with smaller chambers branching from these in various directions but usually with a series of three or four of the smaller chambers extending along one main axis, with shorter series extending laterally, chambers inflated, varying from globular to flattened, from low and broad to elongate and narrow; sutures distinct, depressed; wall calcareous, finely perforate, surface smooth; apertures at the ends of the smaller chambers. Length of holotype 0.55 mm.; length of paratype in figure 11, 0.69 mm.; length of paratype in figure 12, 0.28 mm.; length of paratype in figure 14, 0.55 mm., greatest breadth 0.27 mm.; length of paratype in figure 15, 0.66 mm.; length of paratype in figure 16, 0.41 mm., greatest breadth 0.18 mm.

Types.—Holotype and paratypes of figures 11, 14 and 16 from locality HTL-13, sample 119; paratypes of figures 12 and 15 from locality HTL-57, sample 294.

Remarks.—Tappan (1940) in discussing the occurrence of this species in the Grayson formation, stated that

This form apparently does not fit any of the genera thus far described and its position is extremely doubtful. Some specimens resemble the genus *Schackoina*. . . . The Recent forms *Calcituba polymorpha* Roboz and *Sporadogenerina flintii* Cushman have a somewhat similar irregular appearance and the Grayson form may later be found to belong to one of these genera.

After studying a great many specimens from this and other horizons in the Washita, it is believed that the species represents a new genus, which is here described as *Washitella*. Although a few of the tiny forms seem superficially to resemble *Schackoina*, larger and better-developed ones show a linear arrangement of chambers entirely unlike that genus. *Calcituba* is an attached genus with an imperforate calcareous wall, while the present species is free-living and has a finely perforate wall. *Sporadogenerina* has an early Uvigerine stage, lacking in the present species, and although the later chambers of *Sporadogenerina* are irregularly uniserial, they do not show the branching and growth in various directions from the larger central chambers.

WASHITELLA TRIRADIATA Tappan,
n. sp.

Plate 83, figures 17, 18.

Test medium-sized to small; composed of numerous chambers, arranged in a triaxial linear series and of approximately the same size throughout the length of the test, chambers somewhat rounded in section, of approximately equal length and breadth, probably growth was at first rectilinear, then bifurcation occurred to form the three axes; sutures distinct, depressed; wall calcareous, finely perforate; apertures at the ends of the series of chambers. Length of holotype 0.45 mm., diameter just before bifurcation 0.11 mm.; length of paratype 0.16 mm., diameter of last chamber 0.06 mm.

Types.—Holotype and paratype from locality HTL-13, sample 114.

Remarks.—This species is more similar to *Ramulina* than the preceding as growth is more regular. *Ramulina* in typical development consists of rounded chambers connected by long stoloniferous tubes or of tubular branching unchambered tests, while the present species has closely appressed and well-developed chambers. *W. triradiata*, n. sp. differs from *W. typica*, n. sp. in the tri-axial growth and equal-sized chambers.

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